RF/ER-95-0121.UN

Groundwater Conceptual Plan for the Rocky Flats Environmental Technology Site

Final

FINAL

Groundwater Conceptual Plan for the Rocky Flats Environmental Technology Site

Rocky Mountain Remediation Services, L.L.C.

Environmental Restoration/Waste Management

Sitewide Actions

March 1996

Revision 2

TABLE OF CONTENTS

FIGURES

TABLES

EXECUTIVE SUMMARY

The Groundwater Conceptual Plan provides a basis for cleanup and management of contaminated groundwater at the Rocky Flats Environmental Technology Site (RFETS) consistent with the Rocky Flats Cleanup Agreement (RFCA) Preamble, and the *Action Levels and Standards Framework for Surface Water, Ground Water and Soils*. The Groundwater Conceptual Plan describes the management and cleanup of contaminated groundwater which will be presented in the Accelerated Site Action Plan (ASAP).

Addressing groundwater on a sitewide basis allows for effective coordination of groundwater activities, and provides consistency in addressing groundwater contamination. Because domestic use of groundwater at RFETS will be prevented through institutional controls, the overall goal is to manage or cleanup groundwater in order to protect surface water for all agreed-upon uses. In addition, the Groundwater Conceptual Plan identifies, describes, and ranks the principal groundwater contaminant plumes to provide an initial planning basis for funding, and implementation of groundwater actions.

The lateral extent and spread of contaminants in RFETS groundwater is limited by hydrogeologic conditions, therefore the contaminant plumes are relatively stable. In addition, groundwater discharges to surface water before leaving RFETS and there is a natural vertical barrier to downward migration of contaminated groundwater. Low-permeability claystones form a barrier at least 500-feet thick between contaminated groundwater at RFETS and the Laramie/Fox Hills aquifer.

The volatile organic compound (VOC) contaminant plumes in groundwater have the most potential to impact surface water, and are the primary focus of the Groundwater Conceptual Plan. Contaminant plumes with other, inorganic, constituents were addressed where surface water is impacted above action levels. A two-tiered approach for action levels was developed for groundwater and soils to be protective of surface water uses as well as to be protective of the ecological resources. The Tier-I action levels were developed to identify potential cleanup targets. For groundwater, these were defined as 100 x Federal Drinking Water Maximum Contaminant Level (MCL) for VOCs. Tier-II action levels were developed to identify contaminated groundwater that may impact surface water and were defined on the basis of exceedances above the MCL for individual constituents.

Six groundwater contaminant plumes have been identified where contaminant concentrations exceed the Tier-I action levels. In addition, there are three groundwater plumes that do not exceed the Tier-I action levels, but that may have the potential to impact surface water. These

contaminant plumes are: (1) 881 Hillside Drum Storage Area Plume, (2) Mound Site Plume, (3) 903 Pad and Ryan's Pit Plume, (4) Carbon Tetrachloride Spill Plume, (5) East Trenches Area Plume, (6) Industrial Area Plume, and (7) additional plumes at the Present Landfill, Solar Ponds and Property Utilization and Disposal (PU&D) Yard.

Proposed cleanup actions consist of source removal or containment, with capture and treatment or management of the contaminated groundwater. Using available information, potential actions were conceptually developed for each major groundwater contaminant plume. Based on capture and treatment effectiveness, installation and operating costs, and plant infrastructure requirements, passive captive and treatment methods were the preferred conceptual actions. Before each cleanup action can begin, analyses must be done to select the specific cleanup alternative, and to perform engineering design. Additional data may be needed to ensure the proper placement of cleanup systems.

The groundwater contaminant plumes were ranked based on the methodology previously developed to provide the basis for establishing the priority and sequence of proposed cleanup actions. However, a schedule for implementing groundwater cleanup will be dependent on funding, data sufficiency, resource availability, and the integration with other cleanup and RFETS activities.

1.0 INTRODUCTION

The Groundwater Conceptual Plan has been developed as a joint effort between the Department of Energy Rocky Flats Field Office (DOE/RFFO), Kaiser-Hill, L.L.C. (K-H), Rocky Mountain Remediation Services, L.L.C. (RMRS), the Region VIII Environmental Protection Agency (EPA), and the Colorado Department of Public Health and Environment (CDPHE). This groundwater conceptual plan incorporates the draft Rocky Flats Cleanup Agreement (RFCA) (March 1, 1996), and guidance from the Action Levels and Standards Framework for Surface Water, Ground Water, and Soils Working Group (hereafter referred to as the Working Group). This Working Group was formed to:

- Provide a basis for future decision making,
- Define the common expectations of all parties, and
- Incorporate land- and water-use controls into site cleanup.

1.1 ROCKY FLATS CLEANUP AGREEMENT AND ACCELERATED SITE ACTION PROJECT (ASAP)

The RFCA is the agreement between DOE/RFFO, EPA, and CDPHE to ensure the effective and efficient cleanup of RFETS. The RFCA Preamble summarizes the agreement that environmental cleanup will be implemented through an integrated and streamlined regulatory approach, and defines the approximate areal extent of the five future conceptual land uses: (1) capped areas underlain by waste disposal cells or contaminated materials closed in-place, (2) an industrial-use area, (3) restricted open space; (4) restricted open space because of low levels of plutonium contamination in surface soils, and (5) unrestricted open space.

The RFCA Preamble states that the protection of surface water for the specified uses is the ultimate goal of soil and groundwater management and cleanup. Proposed actions will be designed to protect ecological resources, and will be protective of the appropriate industrial or open space uses. Groundwater will not be used for any purposes at RFETS, except as related to cleanup activities.

ASAP is a strategy to reduce all risks and address closure of RFETS. Therefore, a comprehensive action plan is being formulated to describe how to implement the objectives of the RFCA Preamble and to ensure that, after cleanup, surface water and groundwater leaving the site will be acceptable for any use.

This Groundwater Conceptual Plan was developed using the conceptual RFCA Preamble objectives and the *Action Levels and Standards Framework for the Surface Water, Ground Water, and Soils*. This Groundwater Conceptual Plan will define the alternatives presented in ASAP, and will conceptually describe the management and cleanup of contaminated groundwater, and the actions that will be used to protect surface water and ecological resources.

1.2 PURPOSE OF THE GROUNDWATER CONCEPTUAL PLAN AT RFETS

Groundwater at RFETS is present in the shallow, unconsolidated sediments and subcropping bedrock throughout the site. In the past, each Operable Unit (OU) investigated groundwater within its boundaries without addressing influences from upgradient sources. However, groundwater is not limited by OU or Individual Hazardous Substance Site (IHSS) boundaries. Several sources may contribute to a single groundwater plume, and groundwater plumes may cross several OUs and contribute to surface water contamination a great distance from the source location. Therefore, this sitewide groundwater conceptual plan has been developed to address groundwater issues at RFETS. Figure 1-1 shows the location of the principal areas discussed in the text.

The Groundwater Conceptual Plan addresses groundwater on a sitewide basis, in order to allow effective coordination of groundwater activities, and a consistent approach to addressing groundwater contamination. While remediation of contaminant plumes in groundwater must consider source and plume migration, groundwater cleanup can be performed independently of source remediation. Because there is no exposure pathway to humans from contaminated groundwater, the programmatic goals are to protect surface water and the environment, and limit potential contaminant migration (to the extent possible).

The three specific goals of the Groundwater Conceptual Plan are to:

1) Identify and describe the principal contaminant plumes in groundwater;

2) Rank the contaminant plumes for the purpose of establishing the priority for cleanup actions, in accordance with the method outlined in the "Environmental Restoration Ranking" (RMRS 1995); and

3) Provide an initial planning basis for funding and implementation of groundwater cleanup.

To meet these goals, the Groundwater Conceptual Plan proposes cleanup and/or management of contaminated groundwater through source removal, source control, and/or treatment of dissolved-phase plumes. The Groundwater Conceptual Plan also proposes evaluating whether some areas of contaminated groundwater may remain in place, given that the programmatic goals can be met without active intervention.

1.3 DOCUMENT ORGANIZATION

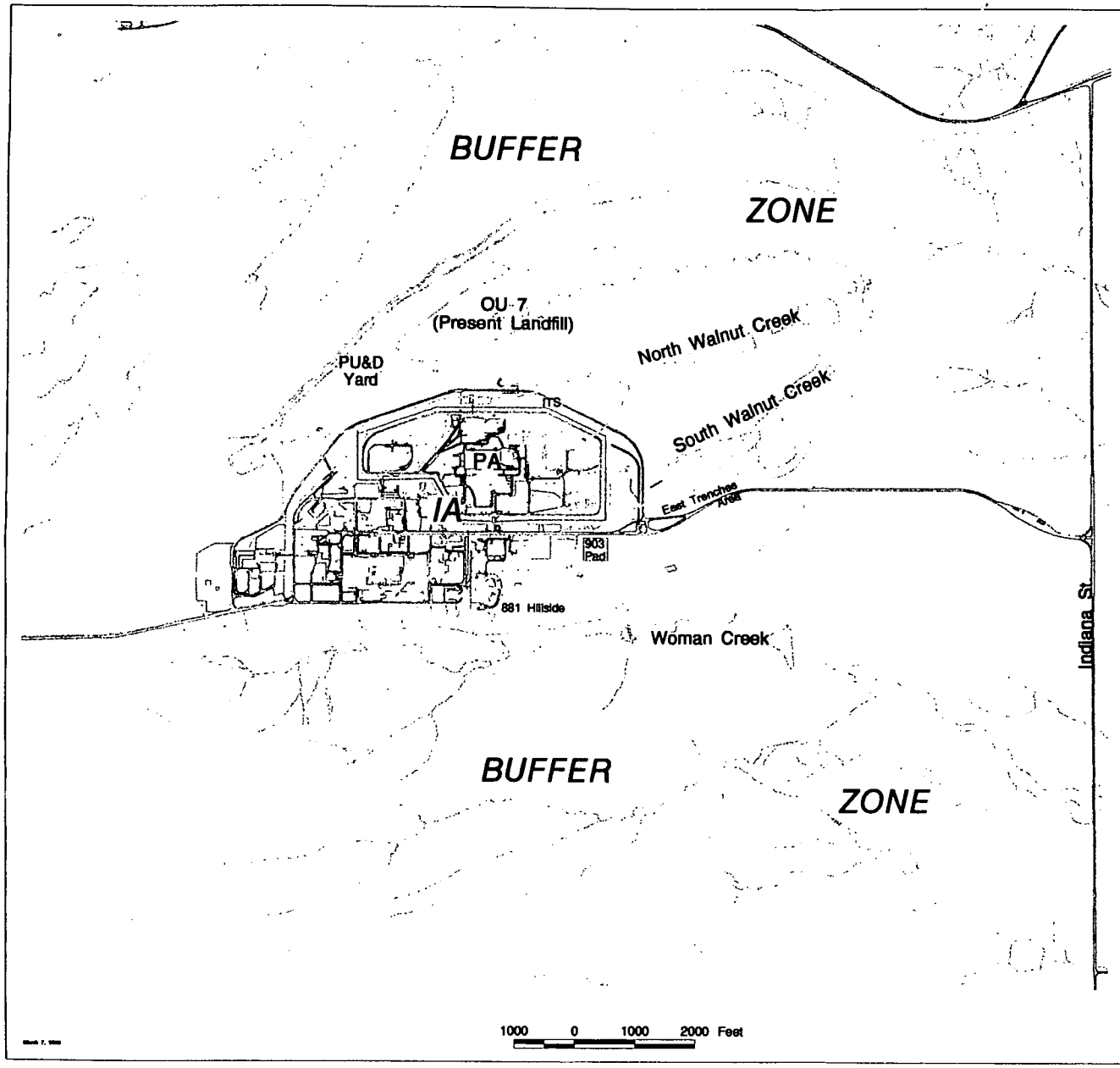
The conceptual plan for groundwater restoration is presented in five sections: (1) Section 1.0 provides an introduction, describes the goals and purpose of the groundwater strategy, and presents the organization of the report; (2) Section 2.0 provides a summary background on groundwater at RFETS; (3) Section 3.0 presents the action levels and standards developed by the Working Group and describes the groundwater monitoring requirements; (4) Section 4.0 describes the various groundwater contaminant plumes present at RFETS and provides an overview of the proposed cleanup actions that may be used; and (5) Section 5.0 summarizes the proposed next steps.

This document also contains two appendices: (1) Appendix A is a list of acronyms used in this text, and (2) Appendix B contains the *Action Levels and Standards Framework for Surface Water, Ground Water, and Soils* developed by the Working Group.

Location Reference Map

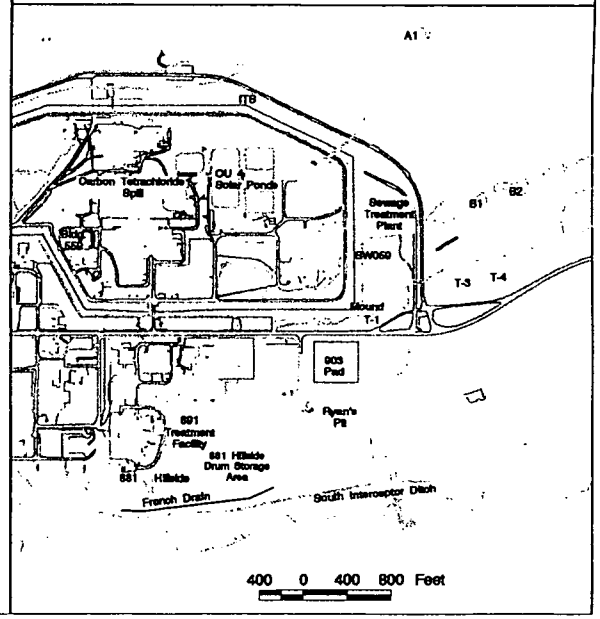
Location of areas of interest refered to in text.

Figure 1-1



N

Detailed View of East Side of Plant Site



2.0 HYDROGEOLOGY AT RFETS

The physical setting is important to understanding the nature of groundwater flow and contaminant transport at RFETS. Sitewide characterization of the geology, hydrology, and groundwater geochemistry at RFETS are presented in a 3-volume set, which includes the "Geologic Characterization Report for the Rocky Flats Environmental Technology Site" (EG&G 1995a), the "Hydrogeologic Characterization Report for the Rocky Flats Environmental Technology Site" (EG&G 1995b), and the "Groundwater Geochemistry Report" (EG&G 1995c). Plume configurations used in the Groundwater Conceptual Plan were generated for the 1995 Well Evaluation Project (unpublished data).

Shallow groundwater at RFETS flows through two distinct layers, each exhibiting common hydrologic and geochemical characteristics, which allow for grouping into two hydrostratigraphic units. These units are generally referred to as the upper hydrostratigraphic unit (UHSU), and the lower hydrostratigraphic unit (LHSU).

The UHSU is the predominant water-bearing unit of concern at RFETS. It consists of unconsolidated, sandy and gravely materials mixed with clay (i.e., alluvium, colluvium, and artificial fill), as well as weathered bedrock claystones and minor bedrock sandstones hydraulically connected to the alluvium. The LHSU consists of unweathered claystone, with some interbedded siltstones and sandstones. There is a significant difference in the ability of each unit to allow groundwater flow. For example, the typical hydraulic conductivity values for the Rocky Flats Alluvium (UHSU) are about 2×10^{-4} centimeters per second (cm/sec), whereas the unweathered Laramie claystones (LHSU) exhibit hydraulic conductivity values of 3×10^{-7} cm/sec, similar to that required for a landfill liner (EG&G 1995b). However, neither the UHSU nor the LHSU has sufficient transmissivity or saturated thickness to be developed as a water source for residential use, although some isolated (i.e., UHSU) bedrock sandstones in OU 2 (EG&G 1992) and valley-fill alluvium in Walnut Creek near Indiana Street (EG&G 1995d) could provide sufficient water to support limited household use.

The spread of contaminants in groundwater at RFETS is limited by hydrogeologic conditions. Generally, groundwater flows slowly at RFETS. For example, using Darcy's Law, the speed of groundwater moving through the Rocky Flats Alluvium in the East Trenches Area is estimated to be about 50 feet per year (assuming hydraulic conductivity is 217.3 ft/yr, effective porosity is 0.1, and the gradient is 0.0213 ft/ft). Because natural processes inhibit or retard the transport of contaminants in groundwater, the speeds at which chlorinated solvents are transported at this location are estimated to range between 2.5 and 25 feet per year, based on applying the

appropriate retardation factors without taking into account dispersion and diffusion. As a result, the extent of the contaminant plumes is not rapidly changing.

The LHSU provides natural vertical containment for the impacted UHSU groundwater. Directly underlying the Industrial Area (IA) low-permeability claystones of the LHSU form a barrier no less than 500 feet in thickness, as shown in Figure 2-1, effectively preventing contaminants from migrating downward to the Laramie/Fox Hills aquifer (modified from EG&G 1995a). By comparison, the average Resource Conservation and Recovery Act (RCRA) landfill is lined with at least 3 feet of similar material. As a result of these stratigraphic relationships, contaminated groundwater emerges as surface water before leaving the site. In addition, there is no known hydraulic connection between domestic wells located offsite and impacted groundwater at RFETS. Horizontal spread of the plumes is mitigated by the low hydraulic conductivity, lack of continuous saturated permeable beds, limited zones of saturation, and high contaminant retardation factors that are characteristic of the clay-rich units comprising the UHSU.

Groundwater in the UHSU preferentially flows along preexisting channels cut into the bedrock (see Figure 2-2). These channels are known to occur in the IA, Solar Ponds, 881 Hillside, 903 Pad, and East Trenches Areas, and possibly the West Spray Field. In addition, groundwater in the IA may preferentially flow along buried sewer lines and process-waste lines. Other hydrogeologic controls for groundwater flow and contaminant transport are hydraulic gradient, distribution of subcropping sandstones and claystones, and topography. Groundwater in the surficial deposits of the UHSU generally flows to the east, following bedrock and surface topography, and discharges to surface drainages where surficial deposits are intersected by drainages. These drainages are the main water pathways offsite. The surface water flow onsite is controlled by artificial impoundments in these drainages.

The available hydrogeologic and isotopic data suggest that faults are not significant conduits for downward vertical groundwater flow to deep aquifers (EG&G 1995a, 1995b, and 1995c). Evidence of limited hydraulic communication between UHSU and LHSU groundwater was found to exist in some wells, but these occurrences do not present a pattern consistent with known fault locations. Isolated fractures in unfaulted bedrock, as opposed to fault-zone fractures, are the most likely mode of transport for UHSU groundwater to reach unweathered bedrock. Due to the thickness and lithology of the LHSU, it is likely that fault zones and fractures become more impermeable with depth, thus reducing the potential for any shallow groundwater flow downward into the Laramie/Fox Hills aquifer.

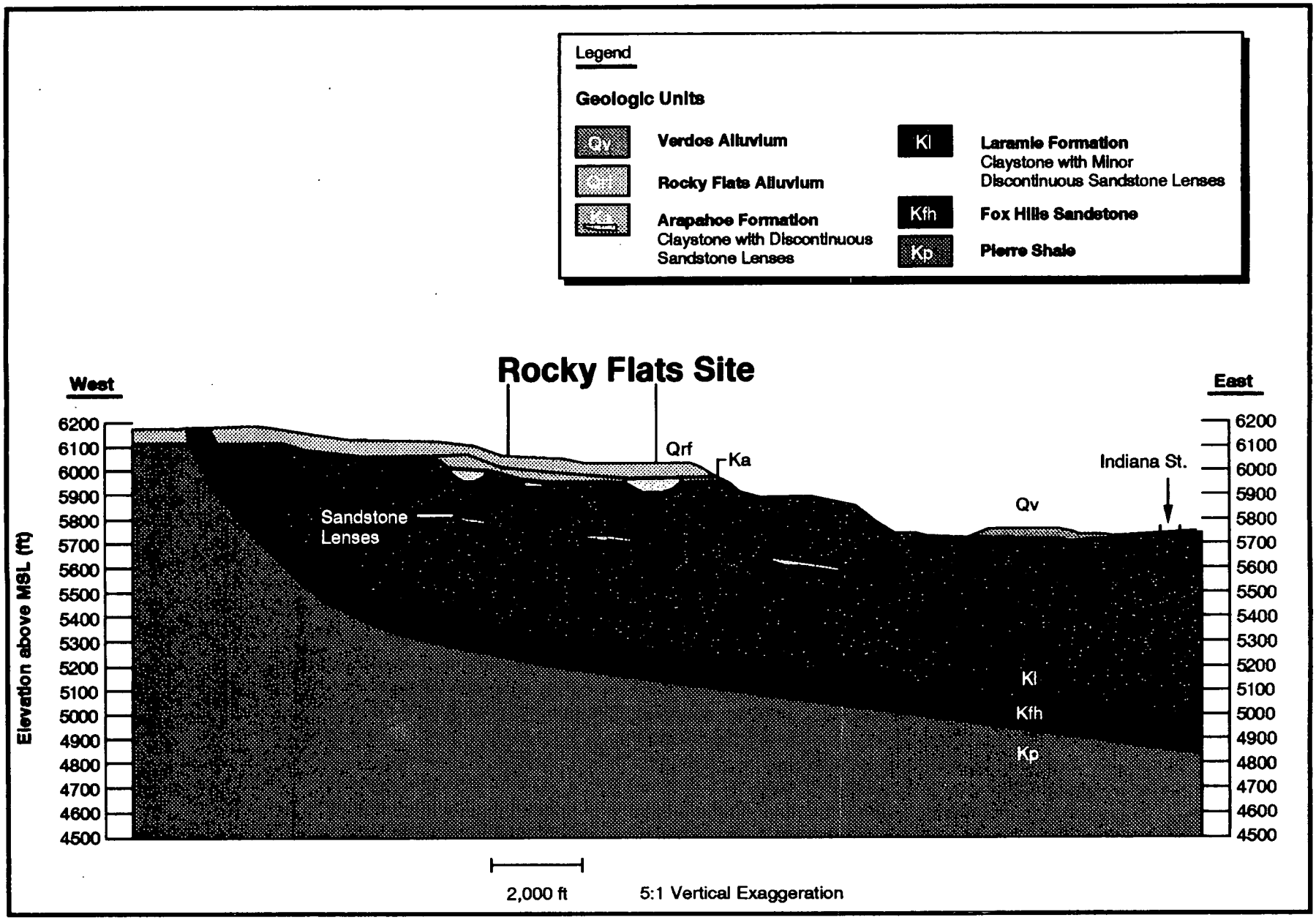
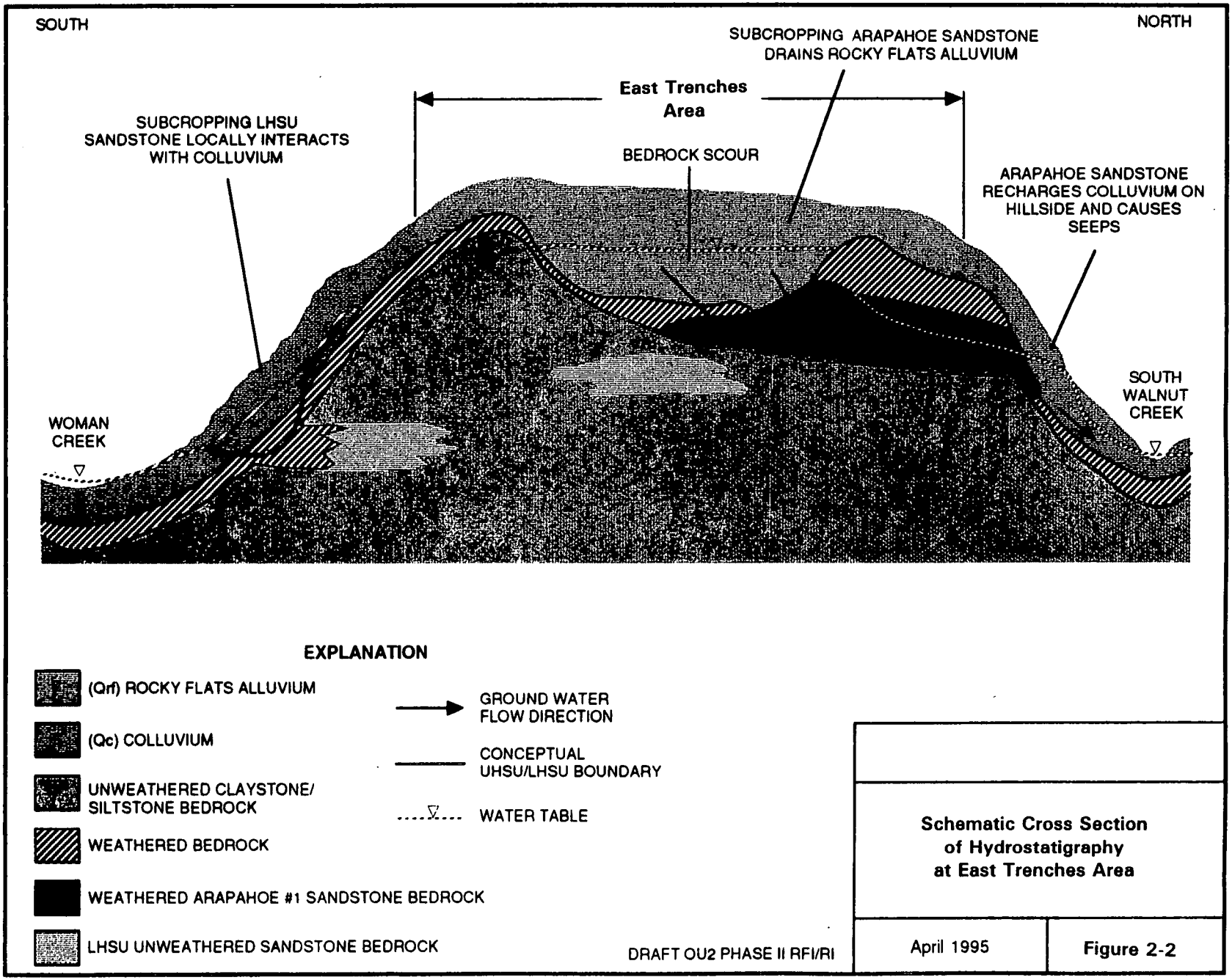


Figure 2-1 Generalized Geologic Cross-Section of the Rocky Flats Area



Schematic Cross Section of Hydrostatigraphy at East Trenches Area

DRAFT OU2 PHASE II RFI/RI

April 1995

Figure 2-2

g95:ES hydrodoc:hydrostat cross-sectn cdw

3.0 ACTION LEVELS AND STANDARDS

The RFCA Preamble was used as the basis for the action levels and standards developed by the Working Group. Protection of surface water is the primary basis for the cleanup and/or management of contaminated subsurface soil and groundwater at RFETS. Surface water, groundwater, and soil cleanup are interrelated, and the Working Group considered all three media in developing a sitewide strategy for RFETS.

The *Action Levels and Standards Framework for Surface Water, Ground Water, and Soils* (February 28, 1996) is attached as Appendix B. The following sections summarize the approaches delineated in this document for monitoring and remediating surface water, groundwater, and subsurface soils for the purpose of protecting surface water.

3.1 SURFACE WATER

Groundwater will be managed to protect surface water. During active remediation, surface water standards and surface water management will be different than those applied after remediation. The standards will be applied at the point-of-compliance located at the outfall of the terminal ponds. These values will be used as action levels above the terminal ponds at existing gaging stations on the main channel.

3.2 GROUNDWATER

As stated in the RFCA Preamble, domestic use of groundwater at RFETS will be prevented through institutional controls. Because no other human exposure to groundwater is foreseen, groundwater action levels are not based on human consumption or direct contact. Instead, action levels for groundwater have been selected to be protective of surface water quality and ecological resources. This framework for groundwater action levels is based on the conclusion that contaminated groundwater emerges as surface water before leaving RFETS.

3.2.1 Action Levels

The Working Group has defined the action levels, for VOCs only, based on Maximum Contaminant Levels (MCLs) for Federal Drinking Water (see Appendix B). MCLs are well-established and accepted values that have been used to guide cleanup at other contaminated sites. Where an MCL for a particular VOC contaminant is lacking, the residential, ingestion-based

Programmatic Risk-Based Preliminary Remediation Goal (PPRG)* value will apply. A two-tiered action level approach to groundwater cleanup and monitoring was developed to protect surface water and identify areas of groundwater contamination potentially requiring cleanup. This approach is presented in the following paragraphs.

Tier-I

Action levels were developed to identify potential cleanup targets in areas where VOC contamination of groundwater exceeds 100 x MCL levels. These action levels identify groundwater contaminant sources that present a higher potential risk to surface water and that should potentially be addressed through an accelerated action. If Tier-I action levels are exceeded, an evaluation is required to determine if remedial or management action is necessary to prevent the highly contaminated (i.e., contaminant concentrations exceeding 100 x MCLs) groundwater from reaching surface water (the evaluation process is described in Section 4.1). If action is necessary, the type and location of the action will be delineated and implemented as an accelerated action. Additional groundwater that does not exceed the Tier-I action levels may also need to be remediated or managed to protect surface water quality or ecological resources. The plume areas to be remediated and the cleanup levels or management techniques used, will be determined on a case-by-case basis. Wells that yield groundwater that is contaminated with VOC concentrations exceeding 100 x MCLs are considered Tier-I wells.

Tier-II

The VOC action levels for surface water protection were developed to prevent contaminated groundwater from reaching surface water, by triggering groundwater management actions when necessary. Tier-II wells are located downgradient of existing plumes, in order to detect the possible spread of the contaminant plumes. If concentrations in a Tier-II well exceed MCLs during a regular sampling event, monthly sampling of that well will be required. Three consecutive monthly samples showing contaminant concentrations greater than groundwater action levels will require a groundwater remedial action. These actions will be determined on a case-by-case basis and will be designed to treat, contain, manage, or mitigate the contaminant plume. Such actions will be incorporated into the Environmental Restoration Ranking and will be given weight according to measured or modeled impacts to surface water.

---

* PPRGs were developed and approved by DOE, EPA, CDPHE, and EG&G to establish sitewide cleanup targets for environmental contamination.

A detailed discussion of where Tier-II action levels will be measured is found in Section 3.2 of Appendix B. Table 3-1 presents a list of three new wells and a subset of existing groundwater monitoring wells that are designated as Tier-II monitoring locations. Figure 3-1 shows the location of Tier-II monitoring wells relative to the composite VOC plumes as described in Section 4.2. Additional Tier-II monitoring wells may be installed, if necessary.

The existing Tier-II wells are currently in the groundwater monitoring network. The new Tier II monitoring wells will be added to the groundwater monitoring network upon completion of well installation and development activities. The results of groundwater sampling and analysis will be integrated with concurrent surface water data for the purpose of evaluating potential impacts to surface water.

Table 3-1 Tier-II Groundwater Monitoring Wells for VOCs

Location Code	Comments
6586	
New Well	Upstream of 6586
New Well	Between B-2 and B-3
75992	
06091	
New Well	Near C-1 (Downgradient of Ryan's Pit)
10194	
1986	
10994	
P314289	
P313589	
7086	
10992	
1786	
1386	
10692	
4087	
B206989	

Groundwater Monitoring

All long-term monitoring requirements for RFETS, along with the Tier-II wells identified in this Groundwater Conceptual Plan, will soon be incorporated into a Groundwater Monitoring and Assessment Plan (GMAP). This document will incorporate two pre-existing plans: (1) the Groundwater Protection and Monitoring Program Plan (GPMPP) (DOE 1993); and (2) the Groundwater Assessment Plan (GWAP) (DOE 1992a). This document will also describe recent changes to the groundwater monitoring network.

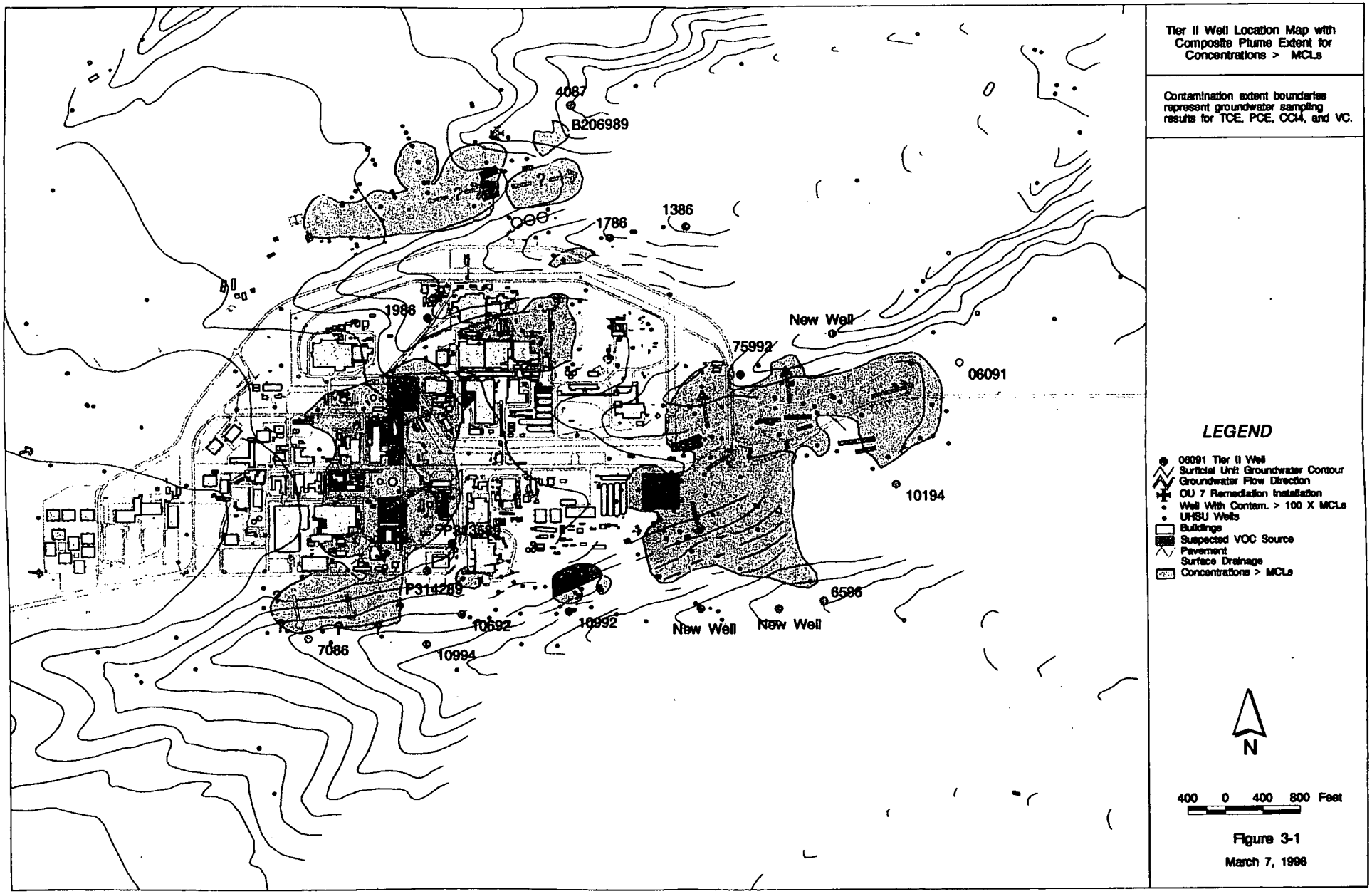


Figure 3-1

March 7, 1996

The GMAP will list the wells with their appropriate regulatory driver, the sampling frequency, and analyte suite, as well as describe data evaluation and reporting methodologies. The GMAP will also reference other implementation plans and decision documents from which the requirements are derived, and will be updated regularly as programmatic changes occur.

The groundwater monitoring network will continue to operate as recently modified by the Groundwater Monitoring Working Group, unless subsequent changes are agreed to by all parties.

Analyte suites, sampling frequency, and specific monitoring locations will be evaluated annually to adjust to changing conditions such as plume migration and increased understanding of contaminant distributions. All groundwater monitoring data, as well as changes in hydrogeologic conditions and any exceedance of groundwater action levels, will be reported quarterly and summarized annually.

All groundwater remedies, as well as some soil remedies, will require groundwater performance monitoring. The amount, frequency, and location of any performance monitoring will be based on the type of remedy implemented and will be determined on a case-by-case basis within the specific decision documents.

3.3 SUBSURFACE SOILS

Action levels for VOCs in subsurface soils were developed to be protective of surface water through groundwater transport. The VOC contaminant plumes in subsurface soil and groundwater have the most potential to impact surface water. However, to provide cleanup guidance, action levels for inorganics that may be of concern at RFETS are currently under development in a manner consistent with that used for VOCs.

The soil VOC levels necessary to be protective of groundwater were calculated using a soil/water partitioning equation and a calculated dilution factor (EPA 1994). The partitioning equation used chemical-specific parameters and site-specific subsurface media characteristics to determine the equilibrium partitioning of a given contaminant between the soil and groundwater. The dilution factor accounts for dilution up to the edge of the source location. Using this approach, subsurface soil contaminant levels that would be protective of groundwater to 100 x MCLs were calculated (see Appendix B).

4.0 GROUNDWATER CONTAMINANT PLUMES AND REMEDIATION

4.1 IDENTIFICATION

The VOC contaminant plumes in groundwater at RFETS have the most potential to impact surface water or to migrate offsite. These plumes have been defined on the basis of exceedances above the MCL for individual constituents (see Figure 3-1). To delineate areas of highly contaminated groundwater, the proposed groundwater action levels of 100 x MCLs were compared against all groundwater data for the most common VOCs in groundwater. The exceedances were plotted and are shown on Figure 4-1 along with proposed locations of the conceptual groundwater actions. The most probable sources were identified using the results of recent field sampling programs and process knowledge. The flow diagram (see Figure 4-2) describes the method used to locate the contaminant plumes and corresponding sources, and to determine which areas should be targeted for remedial action. Other contaminants will also be addressed where there is an impact to surface water exceeding action levels.

There are six groundwater contaminant plumes identified where contaminant concentrations exceed 100 x the MCLs. In addition, there are three plumes with contaminant concentrations that do not exceed 100 x MCLs, but that have the potential to impact surface water. The groundwater contaminant plumes include: (1) 881 Hillside Drum Storage Area Plume, (2) Mound Plume, (3) 903 Pad and Ryan's Pit Plume, (4) Carbon Tetrachloride Spill Plume, (5) East Trenches Area Plume, (6) IA Plume, and (7) additional plumes at the Present Landfill, Solar Ponds, and the Property Utilization and Disposal (PU&D) Yard.

The 903 Pad and Ryan's Pit Plume, the Mound Plume, and the East Trenches Plume are part of a large composite plume on the east side of RFETS. Even though these contaminant plumes overlap, differing sources and flow paths make it effective to treat these parts of the large plume, individually. All of the contaminant plumes in groundwater are discussed in the following section.

4.2 DESCRIPTIONS OF CONTAMINATED GROUNDWATER PLUMES

Areas of contaminated groundwater at RFETS have been identified. Shallow groundwater flows slowly at RFETS and, therefore, it appears that the extent of contaminant plumes in RFETS groundwater is not rapidly changing (see Section 2.0).

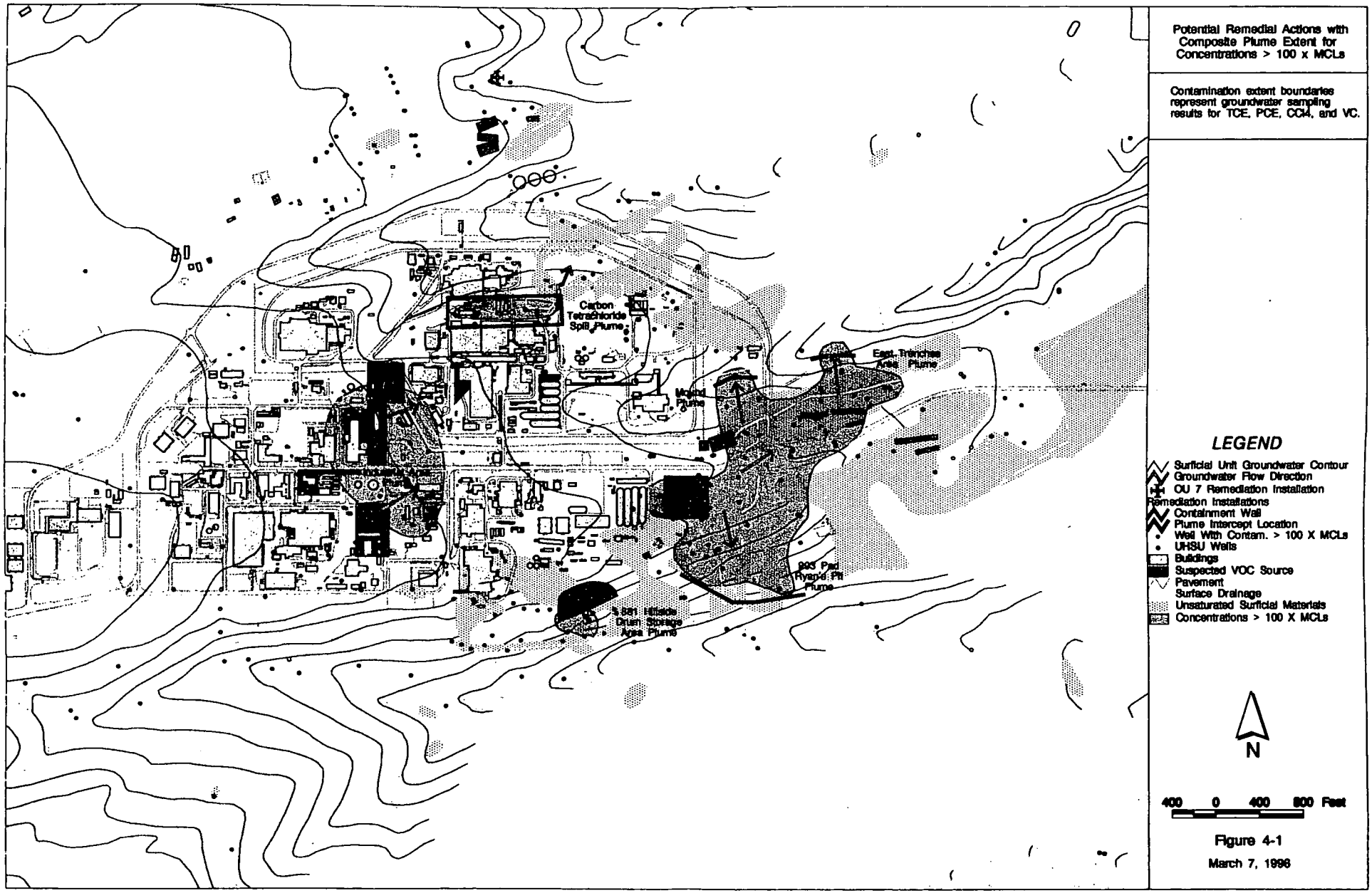


Figure 4-1

March 7, 1996

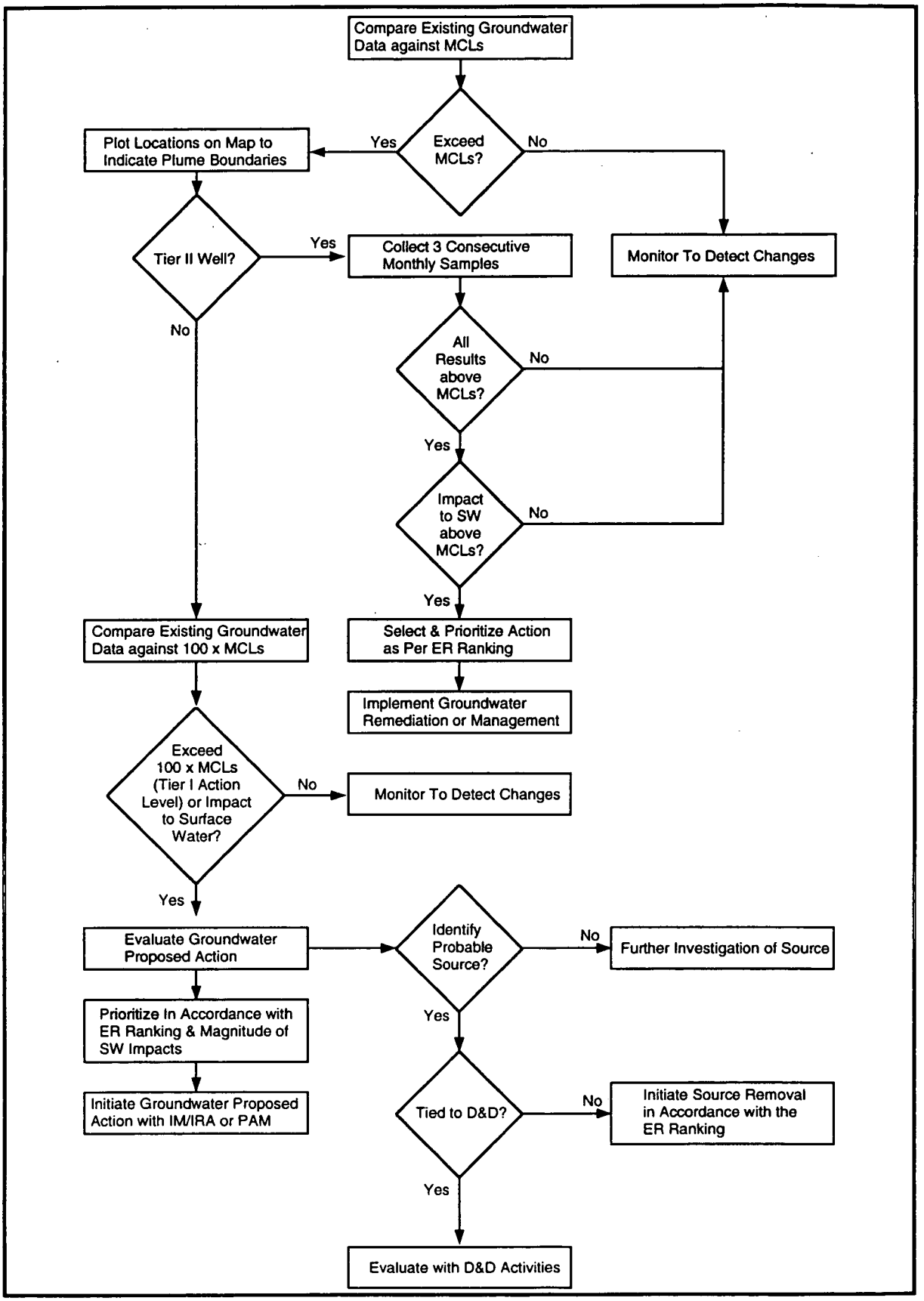


Figure 4-2 Flow Diagram

4.2.1 881 Hillside Drum Storage Area Plume

The drum storage area (IHSS 119.1) within OU 1 is the site of historic releases of chlorinated VOCs to the environment. These releases have resulted in the contamination of shallow alluvial groundwater (i.e., the UHSU) and have formed a small, relatively stable contaminant plume extending down the 881 Hillside. In 1992, a French Drain was installed to intercept contaminated groundwater perceived to be flowing down the 881 Hillside. A 3-ft-diameter recovery well, located within the source area, was also installed to recover water thought to contain high levels of dissolved VOCs.

The French Drain is in operation and is collecting relatively uncontaminated groundwater for treatment at the Building 891 Treatment Plant. The plume is upgradient of the French Drain and does not appear to be migrating. The area immediately downgradient of the French Drain is unsaturated, indicating that the French Drain has dewatered much of the area. A small seep located south of IHSS 119.1 and downgradient of the French Drain along Woman Creek was sampled once. This sample contained a trace amount of VOCs. However, it is not clear if the VOC concentrations in the seep water are related to the contaminant plume.

4.2.2 Mound Site Plume

The Mound Site groundwater contaminant plume is poorly defined, but it is suspected to extend northward from the former location of the Mound where drums were buried, to a point of discharge along South Walnut Creek, upstream of the RFETS Sewage Treatment Plant. Depending on the season, there may be many unsaturated areas within the plume. Dense nonaqueous phase liquid (DNAPLs) in the Mound area are suspected to be the source of the groundwater contamination and the potential exists for contaminant concentrations to increase over time. There is a possibility that Trench T-1 could contribute to this plume; however, evidence indicates that the Mound Site is the primary source.

Contaminated groundwater from the plume contains vinyl chloride, tetrachloroethene, and trichloroethene. The contaminant plume is discharging through surface and subsurface seepage into South Walnut Creek. The contaminated groundwater discharges at a rate of 0.5 gallons per minute, or less, at seep SW059, where it is collected and stored, then later treated at the Building 891 Treatment Facility.

4.2.3 The 903 Pad and Ryan's Pit Plume

This contaminant plume has two, closely spaced sources: (1) VOCs associated with drums formerly stored at the 903 Storage Area, where the contents of the drums leaked into the subsurface and groundwater, and (2) Ryan's Pit where VOCs were disposed of in a trench. The contaminated groundwater flows southward from these two source areas, toward the South Interceptor Ditch and Woman Creek. The groundwater is contaminated with carbon tetrachloride, tetrachloroethene, trichloroethene, and other VOCs. The highest concentrations of VOCs in groundwater are near the 903 Pad and Ryan's Pit sources, although isolated areas of high concentration have been observed within the plume away from these sources. Pure-phase tetrachloroethene and motor fuel constituents were found during the excavation of Ryan's Pit. Pure-phase DNAPLs are also suspected to exist underneath the 903 Pad.

Groundwater flow paths in alluvial materials in the 903 Pad and Ryan's Pit area are relatively well-defined by contact seeps with the underlying bedrock materials and by numerous wells. However, groundwater flow through the hillside colluvium and bedrock is poorly understood. Areas of unsaturated colluvium are fairly common and prediction of local flow paths is difficult. Depending on the season, there may be many unsaturated areas within the plume. Discharge of contaminated groundwater has not been observed from the colluvium or weathered bedrock portion of this plume.

Contaminated groundwater containing tetrachloroethene and trichloroethene may eventually enter the South Interceptor Ditch and Woman Creek surface water pathways if no actions are taken to manage this plume. Discharge of contaminated groundwater into Woman Creek would pose a potential risk to the environment. Collection and treatment of contaminated groundwater from the 903 Pad and Ryan's Pit plume will reduce the risk to the environment posed by uncontrolled releases to surface water.

4.2.4 Carbon Tetrachloride Spill Plume

The Carbon Tetrachloride Spill (IHSS 118.1) is located due north of Building 776 and east of Building 730. There are several documented past releases of carbon tetrachloride at this site. This area also overlaps other IHSSs (i.e., 121-T9, 121-T10, 131, and 144[N]). Different spills are associated with these IHSSs.

IHSS 118.1 is the site where a 5,000-gallon, carbon tetrachloride underground steel storage tank and associated piping were formerly located. Numerous reported spills have occurred, some between 100 to 200 gallons, before 1970, as documented in the Historical Release Report (DOE

1992b). The tank ultimately failed in June 1981 and was subsequently removed, along with a limited amount of soil surrounding the tank. The carbon tetrachloride released from IHSS 118.1 has contaminated surrounding soils and UHSU groundwater in the vicinity of the former tank location.

The numerous releases of carbon tetrachloride have formed a plume of contaminated groundwater, which may eventually reach the North Walnut Creek drainage. During the recent field sampling program, four soil borings were drilled near the IHSS 118.1. Two soil borings intercepted 6 to 8 inches of free-phase carbon tetrachloride at a depth of approximately 25 to 27 feet. Significant soil contamination was also discovered in soil samples collected from several of the borings.

4.2.5 East Trenches Plume

A large plume of contaminated groundwater is located in the East Trenches area. The sources are IHSS 110 (Trench T-3) and 111.1 (Trench T-4), with a minor contribution from the VOCs in the 903 Pad area. The trenches were used to bury sewage sludge from the Sewage Treatment Plant, but also contain DNAPLs, crushed drums, and other miscellaneous waste. Contaminated groundwater occurs within the UHSU, in the alluvium and in the bedrock sandstone that is in hydraulic connection with the alluvium. The major contaminants are carbon tetrachloride, tetrachloroethene, and trichloroethene, as well as other VOCs.

The downgradient boundary of the contaminant plume is located at a spring-and-seep complex on the south bank of South Walnut Creek, above Ponds B-1 and B-2, where the bedrock sandstone subcrops. Concentrations of VOCs above 100 x MCLs have been detected by a recent sampling program conducted at the seep complex. There are potential ecological impacts because water from the contaminant plume containing tetrachloroethene and trichloroethene has reached South Walnut Creek. If concentrations in the seep complex increase over time, a greater contaminant mass may reach surface water.

A lobe of this contaminant plume also extends to the east of the East Trenches area in the alluvium, but has not reached surface water. Uncontaminated alluvial groundwater discharges downgradient of this lobe as seeps in an unnamed tributary drainage to South Walnut Creek. This groundwater will continue to be monitored.

4.2.6 IA Plume

The IA contains a coalesced plume of contaminated groundwater containing trichloroethene thought to emanate from IHSSs 117.1, 117.2, 157.1, 158, and 171; tetrachloroethene thought to emanate from IHSSs 117.1, 117.2, 158, 157.1, 160, and 171; and carbon tetrachloride thought to emanate from IHSSs 117.1, 117.2, and 158. This coalesced plume southwest of Building 559, is outside of the fenced portion of the protected area (PA) and extends downgradient towards the central portion of the IA.

Currently, the IA plume does not appear to be moving, and there are no known or potential surface water impacts. Groundwater recharge in the IA caused by water losses from sewers and water-supply pipelines, may be substantial. Reduction of recharge from these sources could significantly reduce the potential for contaminant migration in the subsurface.

Treatment of contaminated groundwater within the IA does not appear to be necessary to protect surface water, because the plume appears to have limited potential for migration. However, ongoing monitoring and evaluation of the groundwater through the monitoring program will continue, and will detect any possible movement or expansion of the plume. Groundwater remedial actions may become necessary if the contaminant plumes expand and migrate significantly, and become a threat to surface water.

4.2.7 Additional Plumes

Contaminant plumes in the Present Landfill and Solar Ponds groundwater do not contain VOC concentrations greater than 100 x MCLs. However, these plumes are of interest because they are associated with RCRA units. In addition, a VOC plume is located near the PU&D Yard. The setting and status of these plumes is discussed below.

Present Landfill Plume

Contaminant plumes exist in groundwater south and west of the current landfill pond, including a portion of OU 7. Aluminum, manganese, zinc, 2-methylnaphthalene, naphthalene, benzene, and possibly methylene chloride are present downgradient of the current landfill, with average values exceeding MCLs. Groundwater containing contaminant concentrations above MCLs may reach surface water if some remedial action is not taken.

Solar Ponds Nitrate Plume

The Solar Ponds area has historically released nitrates to the environment. The released nitrates have contaminated UHSU groundwater, and have formed a plume that extends northward from the Solar Ponds to the North Walnut Creek drainage above Pond A-1. A small lobe of this nitrate plume extends to the southwest for a short distance. This contaminant plume contains nitrates at concentrations above 100 x MCLs. Nitrate concentrations within the plume are decreasing with time, but still exist at high levels. The Interceptor Trench System (ITS) was installed to intercept contaminants and capture the nitrate plume and was replumbed in 1993 to increase its effectiveness. The ITS captures approximately 2.7 million gallons of water per year, but is not entirely effective in preventing nitrate contamination from impacting the North Walnut Creek drainage (DOE 1994).

PU&D Yard Plume

An area of poorly defined, contaminated groundwater, with VOC concentrations slightly above the MCLs, is located downgradient of the PU&D Yard, which is upgradient of the Present Landfill. Insufficient data are available to identify the source or determine whether there is an impact to surface water. Further investigation is suggested.

4.3 CLEANUP ALTERNATIVES

The goal of this Groundwater Conceptual Plan is to manage and/or cleanup groundwater in order to be protective of surface water. The proposed cleanup of contaminated groundwater involves source removal or source containment, with treatment or management of the contaminated groundwater, to achieve this goal. Conceptual remedies for each major contaminant plume were developed by assessing the available technologies, and proposing a cost-effective, readily available technology.

Both active and passive remedial actions were initially considered. Active treatment actions such as pump-and-treat methods are well-known and accepted, but typically have high operation and maintenance costs, can have a negative impact on wetlands, may consume groundwater, have limited application in clayey aquifers, and are relatively inefficient for DNAPL source removal. Passive treatment actions include passive collection of groundwater with *ex situ* or *in situ* treatment. These systems may have higher initial capital costs, but have lower operation and maintenance costs, low energy consumption, no water consumption, and reduced equipment requirements. Passive treatment will collect DNAPL contaminated groundwater, but also will not remove the source.

The pump-and-treat methodology is commonly used and accepted. EPA has identified the pump-and-treat methodology as one of the most frequently used methods for groundwater remediation, but recognizes that pump-and-treat methods may require decades of potentially expensive operations to achieve cleanup levels (EPA 1992). A preliminary analysis was performed on the potential effectiveness of pump-and-treat methods at RFETS. The analysis concluded that pump-and-treat methods would not be an effective treatment for most contaminant plumes at RFETS, based on the following:

- Neither the UHSU nor the LHSU are capable of producing significant quantities of water, because both have a relatively large clay content.

- Aquifer tests conducted at RFETS show that, for the most part, aquifer yields are low, ranging from 0.000006 gpm to 12 gpm, with an average of 0.3 gpm (EG&G 1995b).

- Factors limiting water production within the UHSU include relatively thin saturated thicknesses and the presence of broad areas that become unsaturated during the fall and early winter (EG&G 1995b).

- Surficial deposits at RFETS have hydraulic conductivities in the 10^{-3} to 10^{-4} cm/sec range, whereas weathered and unweathered claystone bedrock have hydraulic conductivities in the 10^{-7} cm/sec range. The valley-fill alluvium is the most permeable unit, but no contaminant sources are known to be present in this unit.

- Due to the relatively low permeability of the geologic units at RFETS, cones of depression induced by groundwater removal would typically have very steep gradients, requiring a large number of closely spaced wells to effectively implement pump-and-treat remediation.

- Upgradient extraction of groundwater may adversely impact the present widespread distribution of seeps and springs (EG&G 1995b).

- Most of the contaminant plumes in RFETS groundwater have suspected sources consisting of DNAPLs, which are difficult to remediate by using pump-and-treat or passive methods because:

  - DNAPLs have low dissolution rates in water and are denser than water, and therefore tend to sink to the bottom of the unit.

- The high clay content tends to adsorb DNAPLs, making it difficult or impossible to remove.

- Pump-and-treat remediation leaves residual DNAPLs, which will continue to act as a source, further releasing dissolved contaminants to the groundwater system.

It may be possible to implement pump-and-treat methods for groundwater near the East Trenches, where the No. 1 Sandstone is contaminated. However, a large number of closely spaced wells would be required to effectively pump-and-treat groundwater due to the low conductivities and the resulting steep cones of depression. DNAPL contamination could easily remain after treatment. For these reasons, and the associated higher costs for this methodology, the pump-and-treat option was not considered as the proposed remediation treatment in this area.

When properly placed, a passive collection system near the distal ends of plumes will effectively capture the DNAPL-contaminated groundwater, but a contaminated plume would be left upgradient to naturally attenuate (DOE 1995). The contaminants in the plume will degrade with time, and upgradient water will flush the source material toward the collection system.

All proposed actions discussed below were selected to be effective, inexpensive to install and operate, and require minimal plant infrastructure support. For these and the preceding reasons, passive treatment actions are the preferred proposed remediation.

Passive systems proposed for treatment of contaminant plumes in RFETS groundwater include:

- *In situ* passive collection and treatment system such as a funnel and gate, where contaminated groundwater is funneled into a reactive barrier by selective placement of relatively impermeable barriers. Treated water is released back into the groundwater downgradient of the barrier. Such treatment systems have been used effectively at other sites.

- Contaminated water collection from springs, seeps, and/or shallow drains, then pumping the collected water to an existing treatment facility (i.e., Building 891), and discharging the treated water to the surface water system.

- Contaminated water collection from springs, seeps, and/or shallow drains, then using gravity to feed the collected water through a nearby, *ex situ* treatment system, which uses granulated activated carbon, reactive iron, or similar treatment options.

The passive treatments proposed in this plan could use any of these methods and are conceptual in nature. No engineering feasibility analyses were performed and the proposed remedial actions were not evaluated with regard to changing site conditions over time. Before implementation of any remedy, an evaluation will be done to determine the most appropriate, effective, implementable, and cost-effective remedy for each plume of contaminated groundwater. The result of these evaluations will be presented as part of ASAP or in a planning or implementation document such as an Interim Measure/Interim Remedial Action (IM/IRA), along with the data used to make the decision. It is possible that, as a result of these evaluations, different remedial actions will be selected for the different contaminant plumes in RFETS groundwater.

Assumptions

The proposed conceptual remedial actions for treatment of contaminated groundwater were developed using the following assumptions:

- RFETS groundwater will not be used for domestic or other consumptive purposes, and there are no pathways for contaminated groundwater to directly impact human receptors.
- Groundwater will be managed or remediated to protect surface water and to minimize potential ecological impacts due to entering the surface water system.
- Source removals or containment of subsurface soil sources will be designed to prevent further migration of groundwater containing contaminant concentrations greater than 100 x MCLs.
- Remediation and plume management will preserve wetlands where possible.
- Proposed actions will be implemented using cost-effective methodologies.
- Based on preliminary analysis, passive groundwater treatment or containment would appear to be the preferred remedial alternative for most contaminant plumes in RFETS groundwater.
- Performance monitoring will be conducted for all remediation systems to verify effectiveness.

- The remediation and management decisions described herein are based on the existing data set for contaminant plumes, as well as on known technologies that are believed to be applicable to treatment of RFETS groundwater.

- For this plan, the proposed actions are assumed to be passive treatment or containment devices. Passive treatment systems will be sited downgradient from the sources and coincident with the 100 x MCL boundary within the plume, or where otherwise practicable and feasible. The actual remedial actions and location of these actions will be decided on a case-by-case basis and detailed in an IM/IRA or Proposed Action Memorandum (PAM) before implementation.
- An alternatives analysis for any proposed action will be presented as part of ASAP or as an IM/IRA decision document.

- As per RFCA, contaminant plumes in RFETS groundwater which are stable and do not impact surface water above action levels will not require cleanup.

- All remedial actions will be consistent with the proposed end-state of RFETS.

4.4 POTENTIAL CLEANUP ACTIONS

Using available information, the following potential actions were conceptually developed for each major contaminant plume in groundwater. Further analysis of alternatives for feasibility, cost effectiveness, and suitability must be performed before initiating any action. Figure 4-1 shows the conceptual location of the groundwater actions.

4.4.1 Potential Action for the 881 Hillside Drum Storage Area Plume

The final remedy planned for OU 1 is to excavate those soils containing solvent concentrations greater than the Tier-I action levels. Excavating the source will also remove much of the groundwater containing contaminant concentrations above 100 x MCLs in the 881 Hillside Drum Storage Area. After demonstration that this proposed remedy has been effective, and that the source and much of the resulting contaminated groundwater has been removed, the French Drain and recovery well may be removed from operation.

This remedial action will be protective of surface water, and should reduce any potential long-term stress to environmental receptors of contaminants that may reach Woman Creek.

4.4.2 Potential Action for the Mound Site Plume

Cleanup of the Mound Site contaminated groundwater plume will consist of excavating sources exceeding Tier-I action levels for soil cleanup criteria for VOCs. Contaminated materials in Trench T-1 will also be removed using the same criteria. The remedial action proposed for the groundwater with concentrations of VOCs in excess of 100 x MCLs is to collect the plume front before it reaches South Walnut Creek. Interception of the contaminant plume will be accomplished by making improvements to the existing seep collection system at SW059. The contaminated water could then be treated by a system installed along the south bank of South Walnut Creek or at the B891 Treatment Facility.

Containment and treatment of the contaminant plume in Mound Site groundwater will result in a reduction of risk to the environment posed by uncontrolled releases of contaminated groundwater to surface water.

4.4.3 Potential Action for the 903 Pad and Ryan's Pit Plume

The proposed action is to remove contaminant sources exceeding the applicable RFETS soil cleanup criteria for VOCs from the 903 Pad area. Removal of the subsurface soils in the Ryan's Pit area has already been completed. Further groundwater cleanup may be accomplished through a groundwater passive capture and treatment system proposed to be installed at or near the plume boundary which appears to be close to the 100 x MCL isopleth.

4.4.4 Potential Action for the Carbon Tetrachloride Spill Plume

There are two potential actions identified for this groundwater contaminant plume: (1) source removal by using shallow recovery wells to remove as much of the free-phase carbon tetrachloride as possible, and (2) removal of the contaminated soils, adjacent tanks, and associated piping. In addition, the potential remedial action may include the installation of a containment wall around the area at approximately the 100 x MCL boundary, and capping the area with a soil vegetative cover and/or regrading to limit recharge and contaminant leaching.

4.4.5 Potential Action for the East Trenches Plume

The preliminary action is to perform source remediation for Trenches T-3 and T-4 to remove subsurface soils that exceed the applicable RFETS soil cleanup criteria for VOCs. This action is scheduled to occur in FY96. The potential groundwater remediation proposed is to install a plume-capture system near South Walnut Creek, and possibly to use passive technologies to treat the contaminated groundwater.

4.4.6 Potential Action for the IA Plume

This groundwater contaminant plume may not require action because source removal and D&D activities will remove contaminant sources, the source of water in the plume will be reduced over time as capping and/or regrading reduces infiltration, and water loss from the RFETS plumbing will be eliminated. Other alternatives under consideration for actions include diverting groundwater flow upgradient of the IA, and collecting contaminated groundwater within the IA from selected buildings. Preliminary calculations indicate that only 15 percent of the present recharge (precipitation plus groundwater influx) to the IA could be diverted by an upgradient barrier, preventing approximately 4 gallons per minute of groundwater flux from entering the IA.

4.4.7 Potential Actions for Additional Plumes

Present Landfill Plume

An interim remedial action currently under construction will include the installation of a gravity flow system designed to collect the contaminated groundwater and leachate flowing from the landfill for treatment. This system will consist of cement vaults collecting the contaminated water through a gravity-driven system.

Treatment will include a settling basin, bag filters to remove suspended solids, and granular activated carbon to remove organic chemical constituents. Contaminated water will be treated to comply with established cleanup levels. This treatment should effectively mitigate the potential ecological risk from the contaminants of concern. The treatment system may change or be eliminated once the Present Landfill cap is installed, because groundwater migration may no longer be a concern.

Solar Ponds Nitrate Plume

Proposed remedial actions for the groundwater nitrate plume, if required, will be developed at a later date, based on final cleanup standards and site-specific hydrogeologic conditions. No source removal is planned for nitrate-containing media. However, a cap/cover is being considered, which would reduce the groundwater recharge and the flow through the nitrate-contaminated soils.

Recommendations from the Working Group, if approved by the Water Quality Control Commission (WQCC), will change the stream classification for nitrates from drinking water to agricultural. There is some possibility that this surface water will be used for irrigation. Measures

are being implemented which will restrict use of this water for domestic use. If the drinking water classification is lifted, then the nitrate concentrations seen in the surface water as a result of the nitrate plume are acceptable for all of the remaining uses, and could be of benefit for irrigation.

PU&D Yard Plume

Limited field investigation must be completed to determine if there is an impact to surface water before determining whether a potential action is needed.

4.5 PLUME RANKING

When a source or contaminant plume is identified above action levels and determined to be a candidate for remedial actions, a prioritization process is used to determine the sequence in which remediation will occur. A methodology was developed by CDPHE, EPA, K-H, and RMRS staff to rank the known environmental risks at RFETS. This methodology is outlined in the "Environmental Restoration (ER) Ranking" (RMRS 1995). Sites are ranked according to the following criteria: 1) a factor related to concentrations of contaminants present in soil, subsurface soil, and groundwater; 2) a factor characterizing the mobility of the contaminants, and the proximity to surface water; and 3) a factor rating the potential for further release which quantifies the possibility that source material will continue to release contaminants into the environment. The resulting prioritized list is used to determine the general order in which to implement remedial actions.

The Working Group recommended that the groundwater plumes also be prioritized separately from the contaminant sources to allow the groundwater actions to be initiated separately from the source removal actions. The groundwater contaminant plumes described in Section 4.2 were ranked using this methodology, except that the mobility factor was replaced by a factor estimating the impact of the groundwater contaminant plume on surface water. The three factors listed in the preceding paragraph and how they were applied to obtain the plume ranking are as follows:

1) **Score Ratio**: Analytical data for VOCs in groundwater since 1990 were compared to the proposed action levels of 100 x MCLs and a ratio of the analytical result to 100 x MCL value was calculated. The maximum ratio for each analyte within the contaminant plume was tabulated, and a total score for each groundwater plume was calculated by summing the maximum ratios. The resulting summed values were then converted to a Score Ratio using Table 4-1.

2) **Impact to Surface Water**: A rating of 1 to 3 was assigned to each plume based on the evaluation of whether or not the groundwater contaminant plume was impacting surface water (a rating of 3), had the potential to impact surface water (a rating of 2), or did not pose a threat to surface water at this time (a rating of 1). Because contaminants in all plumes are relatively slow moving, the velocity of the groundwater was not used as a factor.

3) **Potential for Further Release**: This factor weighs potential for contaminants to continue to migrate into groundwater (i.e., is an uncontained source present?). A rating of 1 to 3 is assigned based on whether there is probably no uncontained source present (a rating of 1), high concentrations of contaminant are present in soil (a rating of 2), or there is probably free product present (a rating of 3).

Table 4-1 Conversion Table for Scores

Summed Groundwater Ratios	Score Ratio
> 501	10
251 – 500	9
101 – 250	8
76 – 100	7
51 – 75	6
31 – 50	5
21 – 30	4
11 – 20	3
6 – 10	2
1 – 5	1

The results of the prioritization are shown in Table 4-2. When the ER Ranking is recalculated using the new action levels and standards, the groundwater contaminant plumes will be included. In the meantime, the rankings generated for the groundwater contaminant plumes have been compared to the existing ER Ranking to estimate where these actions might be ranked.

The following is an example showing how the three factors were used to generate the ranking for the 903 Pad groundwater contaminant plume. Concentrations of VOCs in groundwater in the 903 Pad and Ryan's Pit plume were identified and compared to the appropriate 100 x MCL

values. The maximum ratios for each contaminant that exceeded 100 x MCL were summed, which equaled a value of 603. Using Table 4-1, this value equated with a Ratio Score of 10.

Next, the impact to surface water was evaluated. Because the contaminants are VOCs, and the area is near surface water, the maximum value of 3 was used. Finally, the potential for further release was believed to be high and a factor of 3 was assigned, based on the belief that there is free product underneath the 903 Pad that is still being released into the groundwater.

Multiplying the Ratio Score of 10 times the impact to a surface water factor of 3, times the factor for potential for further release of 3, generated a ranking score of 90.

Table 4-2 Plume Ranking

Rank	Plume Location	Total Plume Groundwater Location Score	Score Ratio	Impacts to Surface Water Multiplier	Potential for Further Release Multiplier	Total Priority Score	Relative ER Priority List Rank
1	903 Pad/Ryan's Pit Plume	603.4	10	3	3	90	1
2	East Trenches Plume	256.8	9	3	3	81	4
3	Mound Plume	187.9	8	3	2	48	7
4	IHSS 118.1	53.2	6	2	3	36	11
5	IHSS 119.1 Plume (OU1)	87.9	7	2	1	14	13
6	Solar Ponds Nitrate Plume	16.7	3	1	1	3	33
7	South IA Plume	11.9	3	1	1	3	33
8	Landfill Plume (IHSS 114)	—	—	—	—	—	*

Note:
*No ranking value shown because the contaminant concentrations did not approach 100 x MCL (evaluated under RCRA).

5.0 NEXT STEPS

Some additional data must be collected and/or analyzed before implementing actions. In addition, before cleanup of contaminated groundwater can begin, analyses must be done to choose and optimally locate the cleanup. Engineering design must be performed. Additional data may be needed for design and placement of remedial systems. Based on the available information, the following are the proposed next steps:

- Soils in OU 1 881 Hillside Drum Storage Area (IHSS 119.1) that contain contaminant concentrations above action levels would be excavated, removing material above the Tier-I Action Level. Because the source of groundwater contamination would be removed, the use of the French Drain system and recovery well may no longer be necessary. Monitoring will demonstrate the effectiveness of the remedy.

  The seep near Woman Creek will be evaluated to determine whether it is related to the 881 Hillside Drum Storage Area, and if there is an impact to surface water above action levels.

- In the area of the 903 Pad and Ryan's Pit plume, the Mound plume, and the East Trenches plume, sources will be better defined, and those exceeding Tier-I Action Levels may be removed to the extent practical. Contaminated groundwater may be passively directed to a treatment system.

- The area of the carbon tetrachloride spill (IHSS 118.1) would be better defined and evaluated for potential excavation. An impermeable barrier with a surficial cap or cover may be installed to contain the portion of the chlorinated solvent plume that exceeds the 100 x MCL contaminant concentration in groundwater.

- A gravity-flow treatment system will be installed to treat leachate and contaminated groundwater flowing from the Present Landfill. However, this system is designed as an interim measure. Once the Present Landfill is capped, the system will be evaluated and may be modified or eliminated.

- The unknown extent of the chlorinated solvent plumes associated with the PU&D yard (IHSS 170, 174a, and 174b) is a data gap. Because the nature of the southern boundary of these plumes is undetermined, the potential impact to surface water cannot be evaluated. A limited characterization investigation is recommended.

- Soil vegetative caps or covers may be used throughout RFETS where necessary to limit natural recharge caused by precipitation from leaching of contaminants in the unsaturated zone and into groundwater. This would greatly reduce the movement of groundwater through the IA, and thereby reduce the mobility of the contaminant plumes. Subsurface sources of groundwater contamination would be removed where practical. At the end of the D&D/remediation phase, the plant water supply and sanitary sewer will be shut off. This will eliminate a major source of groundwater recharge for the IA, and should greatly reduce the mobility contaminant of plumes originating from the IA.

Further analysis is required to determine optional intercept locations, actual treatment methodologies, and cost-effective project planning and scheduling.

The previous ER Ranking (RMRS 1995) and the ranking of groundwater plumes presented in Section 4.5 provide the basis for establishing the priority and sequence of proposed cleanup actions. However, a schedule for implementing groundwater cleanup will be dependent on funding, data sufficiency, resource availability, and the integration with other cleanup and RFETS activities.

6.0 REFERENCES

DOE, 1992a, *Final Groundwater Assessment Plan*, U.S. Department of Energy, Rocky Flats Plant, Golden, Colorado, February.

DOE, 1992b, *Final Historical Release Report for the Rocky Flats Plant*, U.S. Department of Energy, Rocky Flats Plant, Golden, Colorado, June.

DOE, 1993, *Final Groundwater Protection and Monitoring Program Plan for the Rocky Flats Plant*, U.S. Department of Energy, Rocky Flats Plant, Golden, Colorado, October.

DOE, 1994, *RCRA Report.*

DOE, 1995, *Intrinsic Remediation Monitoring Task 1 Evaluation Report,* U.S. Department of Energy, Rocky Flats Plant, Golden, Colorado, March.

EG&G, 1992, *OU 2 Domestic Water Supply Simulations*, (Internal Report), EG&G Rocky Flats, Golden, Colorado, September, 9p.

EG&G, 1995a, *Geologic Characterization Report for the Rocky Flats Environmental Technology Site*, Volume I of the Sitewide Geoscience Characterization Study, EG&G Rocky Flats, Golden, Colorado, March.

EG&G, 1995b, *Hydrogeologic Characterization Report for the Rocky Flats Environmental Technology Site*, Volume II of the Sitewide Geoscience Characterization Study, EG&G Rocky Flats, Golden, Colorado, April.

EG&G, 1995c, *Groundwater Geochemistry Report for the Rocky Flats Environmental Technology Site*, Volume III of the Sitewide Geosciences Characterization Study, EG&G Rocky Flats, Golden, Colorado, January.

EG&G, 1995d, *1994 Well Evaluation Report for the Rocky Flats Environmental Technology Site (Final),* EG&G Rocky Flats, Golden, Colorado, March.

EPA, 1992, *Chemical Enhancements to Pump-and-Treat Remediation*, U.S. Environmental Protection Agency EPA/540/S-92/001.

EPA, 1994, *Draft Soil Screening Guidance*, U.S. Environmental Protection Agency, EPA/540/R-94/101.

RMRS, 1995, *Environmental Restoration Ranking*, RMRS Rocky Flats, Golden, Colorado, September 27.

ASAP	Accelerated Site Action Plan
CDPHE	Colorado Department of Public Health and Environment
D&D	Decontamination and Decommissioning
DNAPL	Dense Nonaqueous Phase Liquid
DOE/RFFO	Department of Energy/Rocky Flats Field Office
EPA	Environmental Protection Agency
GMAP	Groundwater Monitoring and Assessment Plan
GPMPP	Groundwater Protection and Monitoring Program Plan
GWAP	Groundwater Assessment Plan
IA	Industrial Area
IHSS	Individual Hazardous Substance Site
IM/IRA	Interim Measure/Interim Remedial Action
ITS	Interceptor Trench System
K-H	Kaiser-Hill
LHSU	Lower Hydrostratigraphic Unit
MCL	Federal Drinking Water Maximum Contaminant Level
OU	Operable Unit
PA	Protected Area
PAM	Proposed Action Memorandum
PPRG	Programmatic Risk-Based Preliminary Remediation Goal
PU&D	Property Utilization and Disposal
RCRA	Resource Conservation and Recovery Act
RFCA	Rocky Flats Cleanup Agreement
RFETS	Rocky Flats Environmental Technology Site
RMRS	Rocky Mountain Remediation Services, L.L.C.
SNM	Special Nuclear Material
TRU	transuranic
UHSU	Upper Hydrostratigraphic Unit
VOC	Volatile Organic Compound
WQCC	Water Quality Control Commission

Appendix B

Rocky Flats Environmental Technology Site

Action Levels and Standards Framework for Surface Water, Ground Water, and Soils

Rocky Flats Environmental Technology Site

RFCA Attachment 5
Action Levels and Standards Framework for Surface Water, Ground Water, and Soils

Table of Contents

Attachments

Figure 1	Conceptual RFETS Land Uses
Table 1	Surface Water Action Levels and Standards
Table 2	Ground Water Action Levels
Table 3	Tier II Ground Water Wells
Table 4	Tier I Subsurface Soil Action Levels
Table 5	Surface Soil Action Levels
Table 6	Summary of Recommended Changes to Use Classifications and Standards Requiring Action by the Colorado Water Quality Control Commission

1.0 General Background

1.1 Goal of Action Levels and Standards Framework

On October 10 and 11, 1995, a "Workout Session" was convened between DOE, EPA, CDPHE, DNFSB, and Kaiser-Hill to resolve, or develop a path to resolve, all outstanding issues associated with the new Rocky Flats Cleanup Agreement (RFCA). Several of the significant Workout Session outcomes included agreement on the Objectives presented in the RFCA Preamble and agreement that the environmental cleanup of the site will now be implemented through an integrated and streamlined regulatory approach. In addition, the approximate areal extent of four future conceptual land uses was developed. These include capped areas underlain by either waste disposal cells or contaminated materials closed in-place, an industrial use area, a restricted open space area, another restricted open space area with low levels of plutonium contamination in surface soils, and an unrestricted open space area that, while it would be managed as open space, actually could be available for any use. The revised map delineating these areas is now attached to this document as Figure 1.

As a result of the 1995 Workout Session, a working group consisting of DOE, EPA, CDPHE, and Kaiser-Hill teams was formed to develop a consensus proposal for the appropriate cleanup standards that should apply to RFETS. This Action Levels and Standards Framework presents the final recommendation of the working group and is summarized in Summary Tables 1 and 2. It has been developed in a manner generally consistent with the Preamble Objectives. In some cases, the working group found it necessary to more precisely define aspects of the Objectives so that applicability of action levels and required mitigating actions could be completely defined. The goal of the Action Levels and Standards Framework is to:

a. provide a basis for future decision-making,
b. define the common expectations of all parties, and
c. incorporate land- and water-use controls into site cleanup.

This document describes the parties' commitments and recommendations for both action levels and standards. Action levels are numeric levels that, when exceeded, trigger an evaluation, remedial action, and/or management action. Action levels will not necessarily be the same as cleanup levels which must be achieved for a remedial action to be complete. A standard is an enforceable narrative and/or numeric restriction established by regulation and applied so as to protect one or more existing or potential future uses. Within this framework, standards are associated with surface water use classifications and applied at points of compliance. Standards are not being directly applied to ground water or soils. Closure performance standards apply to RCRA units and are explained in the RFCA.

Protection of all surface water uses with respect to fulfillment of the Intermediate and Long-Term Site conditions will be a basis for making soil and ground water remediation and management decisions. Actions will be designed to prevent adverse impacts to ecological resources and

ground water consistent with the Action Levels and Standards Framework. Because the Action Levels and Standards Framework does not address the inherent value of ground water, any residual effects on ground water not addressed through this Framework will be addressed under a Natural Resources Damage Assessment (NRDA).

Much of this Framework is based on Maximum Contaminant Levels or MCLs. MCLs have been established for many chemical contaminants and represent the maximum permissible level of a contaminant in drinking water.

1.2 Programmatic Assumptions

The working group developed this framework using the following inter-related programmatic or site-wide assumptions:

1. The framework must be consistent with the RFCA Preamble.
2. Implementation of the framework must protect human health and the environment.
3. Implementation of the framework must protect surface water uses and quality.

1.3 Action Prioritization and Implementation

Remedial decisions will be supportive of Intermediate and Long-Term Site conditions. Actions required as a result of exceedances of the standards or action levels described in this document will be prioritized on the Environmental Restoration (ER) Ranking. The ER Ranking will, in turn, be considered in the Budget and Work Planning Process (RFCA, Part 15). These interim remedial decisions may be implemented by means of an accelerated action (PAM or IM/IRA) or addressed as necessary in the ROD for the affected area. Actions will be developed in an integrated manner with other actions being taken and will be consistent with best management practices.

1.4 Outside Factors

Several factors outside the control of the Working Group. Foremost among these factors is the Water Quality Control Commission (WQCC). The WQCC determines water quality standards throughout Colorado. The consensus position presented herein recommends several changes to existing use designations and standards for water at RFETS (see Table 6). There is no guarantee that the WQCC will make the changes this document recommends.

Another factor that could affect the positions presented in this document is public response to the Revised Vision, the RFCA, and this Framework. Specifically, the response of the local municipalities including Westminster, Broomfield, Thornton, and Northglenn, will be extremely important in finalizing these recommendations for standards and action levels.

SUMMARY TABLE 1: ACTION LEVELS AND STANDARDS FRAMEWORK

SURFACE WATER - During Active Remediation (Near-Term Site Condition)

Surface Water		Action Levels (with temporary modifications, as appro.)		Action	Point of Eval.	Standards (with temporary modifications, as appro.)		Action	Point of Compliance
	Segment 4					Non-Rads: -Rec 2 -Agricultural -Aquatic Life Warm 2 -Water Supply (nitrate = 100 ppm)	Rads: -Pu = 0.15 pCi/l -Am = 0.15 pCi/l -All other rads: existing stds	Notification, source eval, mitigation if appro.	Terminal Pond Outfalls
	Segment 5	Non-Rads: organics = MCLs inorganics/metals = -Rec 2 -Agricultural -Aquatic Life Warm 2 -Water Supply (nitrate = 100 ppm)	Rads: -Pu = 0.15 pCi/l -Am = 0.15 pCi/l -All other rads: existing stds	Notification, source eval, mitigation if appro.	Within ponds and in main stream channels, at existing monitoring stations				

SURFACE WATER - After Active Remediation (Intermediate and Long-Term Site Condition)

Surface Water		Action Levels (1)		Action	Point of Eval.	Standards (2)		Action	Point of Compliance
	Segment 4					Non-Rads: -Rec 2 -Agricultural -Aquatic Life Warm 2 -Water Supply	Rads: -Pu = 0.15 pCi/l -Am = 0.15 pCi/l -All other rads: existing stds	Notification, source eval, mitigation if appro.	Terminal Pond Outfalls unless ponds gone; if ponds gone, TBD
	Segment 5					Non-Rads: -Rec 2 -Agricultural -Aquatic Life Warm 2 -Water Supply	Rads: -Pu = 0.15 pCi/l -Am = 0.15 pCi/l -All other rads: existing stds	Notification, source eval, mitigation if appro.	Terminal Pond Outfalls unless ponds gone; if ponds gone, TBD

(1) After active remediation, the concept of action levels in surface water no longer be necessary. All action levels will either be discontinued (MCLs) and/or convert to enforceable standards.

(2) Standards for Segment 4 and Segment 5 become identical when the period of active remediation is concluded.

SUMMARY TABLE 2: ACTION LEVELS AND STANDARDS FRAMEWORK

OTHER MEDIA - During Active Remediation (Near-Term Site Condition)

Other Media	Tier I				Tier II			
	Action Level	Action	Cleanup Level	Point of Compliance	Action Level	Action	Cleanup Level	Point of Measurement
Ground Water	100 X MCLs[1] and protection of surf wtr and eco resources	Remedial or management action (accelerated)	Protective of surf wtr and eco resources	None; applies across RFETS	MCL[1]	Plume evaluation, plume mgmt if necessary	Protection of surf wtr and eco resources	In designated Tier II gnd wtr monitoring wells
Subsurface Soil	Protective of 100 X MCLs[1] in ground water	Source removal (accelerated)	Protective of 100 X MCLs[1] in ground water	None; applies across RFETS	Protection of surf wtr and eco resources.	Source eval, remediation/mgmt if appro.	Protection of surf wtr and eco resources.	Actual or predicted exceedances in surface water of surface water action levels or standards.
Surface Soil	10^{-4} carcinogenic risk for use scenarios OR 15 mrem/yr dose	Remediation (accelerated)	Protective of human health for use scenarios	None; applies across RFETS	10^{-4} carcinogenic risk and protection of surf wtr and eco resources.	Source eval, remediation/mgmt if appro.	Protection of human health, surf wtr, and eco resources	Human health: none; applies across RFETS. surf wtr: actual or predicted exceedances in surf wtr of surf wtr action levels or standards.

(1) For chemicals w/out an MCL, domestic use 10-6 "Programmatic Preliminary Remediation Goals" (PPRGs) will be used. The reason for this is that the PPRG is the closest to MCL derivation.

OTHER MEDIA - After Active Remediation (Intermediate and Long-Term Site Condition)

The Action Level and Standards Framework will continue in effect until the need for land and water use control is mitigated. When the Intermediate Site Condition is achieved, on-going monitoring and maintenance of RFETS will continue. Should monitoring identify some off-normal contaminant migration event, decisions about any necessary remediation will be made consistent with the Action Levels and Standards Framework.

2.0 SURFACE WATER

2.1 Some of the surface water quality standards and action levels proposed in this section differ from the existing state water quality standards (see Table 6). It will be necessary, therefore, to petition the Water Quality Control Commission (WQCC) for these changes. Petitions must provide sufficient rationale and justification to document that all water uses presented in the Vision will be protected, and will be supported by all parties. Once these changes to the water quality standards have been made, EPA will issue a new NPDES permit within six months of WQCC action. Local municipalities will be involved and consulted in surface water decisions.

Surface water exists in Areas 2, 3 and 4 on Figure 1, as well as immediately off-site. The standards, action levels and points of compliance presented below are based on the following refinement of the areas (this assumes current pond water-transfer configurations):

A. Area 2 (restricted open space) will include all surface water down to, and including, the terminal ponds (Ponds A-4 and B-5) in Walnut Creek. For Woman Creek, only Pond C-2 is in Area 2. Therefore, the surface water in Area 2 is consistent with Segment 5 of Big Dry Creek.

B. Areas 3 and 4 (restricted open space (Pu) and unrestricted open space) will include the streams from the terminal ponds to the plant boundary in Walnut Creek and all of Woman Creek except Pond C-2. The surface water in Areas 3 and 4 is part of Segment 4a/4b of Big Dry Creek.

2.2 Numeric Levels During Active Remediation (Near-Term Site Condition)
During the period of active remediation, the Table 1 values will apply as standards in Segment 4a/4b of Big Dry Creek and as action levels in Segment 5. This surface water framework reflects the current classifications set by the WQCC. Any future changes to the classifications made by the WQCC will be incorporated into this document.

A. Non-radionuclides

1. The numeric values that will apply throughout both stream segments are based on surface water use classifications consistent with the uses described in the RFCA Preamble:

   Water Supply
   Aquatic Life - Warm 2
   Recreation 2
   Agricultural

2. Numeric values will be derived from the following:

   a) Metals - the lower of either the Aquatic Life values listed in Table III of the Basic Standards and Methodologies for Surface Water or the Segment Specific Water Quality standards apply.

   b) Inorganics - Segment-Specific Water Quality standards apply, except

for nitrate which will equal 100 mg/L (agricultural use value).

c) Any contamination in surface water resulting from releases from a unit at RFETS subject to RCRA interim status requirements will be addressed through this Action Levels and Standards Framework and through remedial actions rather than through RCRA closure (see Attachment 10 to RFCA, RCRA Closure for Interim Status Units). This would include surface water containing nitrates that has been impacted by the Solar Ponds ground water plume. Addressing the nitrates through this Framework will allow these waters to be managed in a more cost-effective and flexible manner. The parties recognize that changes in the management of nitrates may cause the surface water to more routinely approach the current 10 mg/L standard at the point of compliance unless and until the WQCC changes the nitrate standard to 100 mg/L.

d) Organic Chemicals:

1 - In Segment 4a/4b, water quality standards will apply in accordance with the use classifications identified in 2.2.A.1 above.

2 - In Segment 5, the organic chemical MCLs will apply (Table 1). Therefore, the underlying Segment 5 organic standards will not apply during the period of active remediation.

3. Temporary modifications to the numeric values during active remediation may be developed through subsequent working group efforts.

a) The basis for proposing the temporary modifications may include one or more of the following:

1 - A determination of ambient conditions in a manner similar to the existing Segment 5 temporary modifications;

2 - A mass-balance equation that calculates maximum influent concentrations in Segment 5 that will be protective of numeric values at Segment 4a/4b points of compliance without allowing treatment within waters of the State;

3 - Some other methodology agreed to by all parties.

b) These temporary modifications should be developed together with other stakeholders (i.e., the local municipalities that are impacted by surface water from the Site).

2.2 B. Radionuclides

1. Numeric values for plutonium and americium are risk-based (10^{-6} increased carcinogenic risks to human health from direct exposure including consumption). This is not consistent with the rest of the Framework which considers reasonably expected uses during active remediation. Drinking water supply is not expected for RFETS surface water during the period of active remediation.

2. The numeric values are:
   0.15 pCi/L for plutonium
   0.15 pCi/L for americium
3. If necessary, higher event-related and/or seasonal (limited duration) values for each drainage will be developed for plutonium and americium through subsequent working group efforts by June 1, 1996. The working group efforts will be focused on a statistical evaluation of existing baseflow and event data as well as on-site water management with the goal of minimizing off-site migration of plutonium and americium in surface water. Higher values should be developed together with other stakeholders (i.e., the local municipalities that are impacted by surface water from the Site). The working group will develop a process to actuate these higher numeric values. In addition, the Pond Operations Plan, which includes specific responses for identified circumstances and preserves dam safety, will guide specific decisions for the release of water.
4. Numeric values for other radionuclides will be the site-specific standards found in Table 2 of 5 CCR 1002-8, §3.8.0. The parties will re-examine these values based upon conditions in the basins and will propose alternative values if appropriate.

C. Points of Compliance/Action Level Measuring Points

1. In Segment 4a/4b, points of compliance will be placed at the existing sampling locations for the outfalls of the terminal ponds (Ponds A-4, B-5, and C-2) in both Walnut Creek and Woman Creek. Since all of Woman Creek is within Segment 4b and because of the complex water transfer configurations, additional points of compliance may need to be established by the parties.
2. In Segment 5, exceedance of action levels will be measured in the ponds and upstream in the main stream channel at existing gaging/sampling stations or at additional sampling sites in the main stream channel as necessary.
3. Compliance will be measured using a 30-day moving average for those contaminants for which this is appropriate. When necessary to protect a particular use, acute and chronic levels will be measured differently as described in current sampling and analysis plans.

2.3 Standards After Active Remediation (Intermediate and Long-Term Site Condition)

When the Intermediate Site Condition is achieved following completion of active remediation, the surface water must be of sufficient quality to support any surface water use classification in both Segments 4a/4b and 5. Any temporary modifications will be removed. Points of compliance will be at the outfalls of the terminal ponds. However, all final remedies must be designed to protect surface water for any use as measured at

all final remedies must be designed to protect surface water for any use as measured at the nearest and/or most directly impacted surface water in Segments 4a/4b and 5. Interim remedies will be consistent with this as a goal. If the terminal ponds are removed, new monitoring and compliance points will be designated and will consider groundwater in stream alluvium.

2.4 Action Determinations

A. When contaminant concentrations exceed the Table 1 standards at a point of compliance, source evaluation and mitigating action will be required. Specific remedial actions will be determined on a case-by-case basis, but must be designed such that surface water will meet applicable standards at the points of compliance. In the case of standards exceedances at a point of compliance, DOE will inform the CDPHE and EPA of such exceedances within 15 days of gaining knowledge of the exceedances. In addition, DOE will, within 30 days of gaining knowledge of the exceedances, submit to CDPHE and EPA a plan and schedule for source evaluation for the exceedance, including a preliminary plan and schedule for mitigating action. Final plans and schedules for mitigating actions will be developed and implemented by DOE, in consultation with CDPHE and EPA, following completion of the source evaluation. Nothing in this paragraph, however, shall preclude DOE from undertaking timely mitigation once a source has been identified. Once an initial notification, source evaluation, and mitigating action have been triggered for a particular exceedance, additional exceedances from the same source would not require separate notifications or additional source evaluations or mitigation.

B. During active remediation, when contaminant concentrations in Segment 5 exceed the Table 1 action levels, source evaluation will be required. If mitigating action is appropriate, the specific actions will be determined on a case-by-case basis, but must be designed such that surface water will meet applicable standards at the points of compliance. In the case of action level exceedances in Segment 5, DOE will inform the CDPHE and EPA of such exceedances within 15 days of gaining knowledge of the exceedances. In addition, DOE will, within 30 days of gaining knowledge of the exceedances, submit to CDPHE and EPA a plan and schedule for source evaluation for the exceedance, including a preliminary plan and schedule for mitigating action. Final plans and schedules for mitigating actions will be developed and implemented by DOE, in consultation with CDPHE and EPA, following completion of the source evaluation. Nothing in this paragraph, however, shall preclude DOE from undertaking timely mitigation once a source has been identified. Once an initial notification, source evaluation, and mitigating action (if appropriate) have been triggered for a particular exceedance, additional exceedances from the same source would not require separate notifications or additional source evaluations or mitigation.

C. Exceedances of water quality standards at a point of compliance may be subject to civil penalties under sections 109 and 310(c) of CERCLA. In addition, failure of DOE to notify CDPHE and EPA of such exceedances, or to undertake source evaluations or mitigating actions as described in paragraph 2.4.A, above, shall be enforceable consistent with the terms of Part 16 of the RFCA.

D. Exceedances of action levels in Segment 5 shall not be subject to civil penalties. However, failure of DOE to notify CDPHE and EPA of such exceedances, or to undertake source evaluations or mitigating actions (if appropriate) as described in paragraph 2.4.B, above, shall be enforceable consistent with the terms of Part 16 of the RFCA.

2.5 Surface Water Monitoring

A. Surface water monitoring will continue as currently established unless subsequent changes are agreed to by all parties.

B. All parties will receive quarterly surface water monitoring reports which will highlight any exceedances of surface water standards or action levels and any significant changes to surface water flow conditions.

3.0 GROUND WATER

3.1 Action levels for ground water must be protective of surface water standards and quality as well as the ecologic resources. Domestic use of ground water at RFETS will be prevented through institutional controls. Since no other human exposure to on-site ground water is foreseen, ground water action levels are based only on surface water protection. This framework for ground water action levels assumes that all contaminated ground water emerges to surface water before leaving the site.

3.2 Action Levels: The strategy for ground water is intended to prevent contamination of surface water. This protectiveness can be achieved by applying Maximum Contaminant Levels (MCLs) as ground water action levels. Where an MCL for a particular contaminant is lacking, the residential ground water ingestion-based PPRG value will apply.

A. Tier I - Near-Source Action Levels for Accelerated Actions:

1. Action levels = 100 x MCLs (see Table 2).
2. Applies in areas of high ground water contaminant concentrations.
3. Designed to identify high concentration ground water "sources" that should be addressed through an accelerated action.

B. Tier II - Surface Water Protection Action Levels:

1. Action levels = MCLs (see Table 2).
2. Designed to prevent surface water from exceeding surface water standards/action levels by triggering ground water management actions when necessary.
3. Situations where ground water is contaminating or could contaminate surface water at levels above surface water standards/action levels will trigger a Tier II action.
4. Tier II Action Levels are to be measured in designated wells:
   a) Tier II wells have been selected by all parties from the existing monitoring network where practical. New wells have been proposed where apparent gaps exist. Designated Tier II wells are listed in Table 3.
   b) Tier II wells are either currently uncontaminated or contaminated at levels less than MCLs. In general, Tier II wells are located between the downgradient edge of each plume and the surface water towards which the plume is most directly migrating.
   c) If the proposed new wells are shown to be contaminated or if additional plume information dictates, new or alternate wells will need to be chosen.

3.3 Action Determinations

A. Tier I

1. If Tier 1 action levels are exceeded, an evaluation is required to determine if remedial or management action is necessary to prevent surface water from exceeding standards. If this evaluation determines that action is necessary, the type and location of the action will be delineated and implemented as an accelerated action. This evaluation may include a trend analysis based on existing data. Accelerated action priority will be given to plumes showing no significant decreasing trend in ground water contaminant concentrations over 2 years.
2. Additional ground water that does not exceed the Tier I action levels may still need to be remediated or managed through accelerated actions or RODs to protect surface water quality or ecological resources and/or prevent action level exceedances at Tier II wells (e.g., lower-level, but fast-moving contamination). The plume areas to be remediated and the cleanup levels or management techniques utilized will be determined on a case-by-case basis.

B. Tier II

1. If concentrations in a Tier II well exceed MCLs during a regular sampling event, monthly sampling in that well will be required. Three consecutive monthly samples showing contaminant concentrations greater than MCLs will trigger an evaluation. This will require a ground water remedial action, if modelling, which considers mass balancing and flux calculations and multiple source contributions, predicts that surface water action levels will be exceeded in surface water. These actions will be determined on a case-by-case basis and will be designed to treat, contain, manage, or mitigate the contaminant plume. Such actions will be incorporated into the ER Ranking in which they will be given weight according to measured or predicted impacts to surface water.
2. Ground water contaminated at levels above ground water action levels currently exists at several locations. Each of these situations will be addressed according to appropriate decision documents.
3. Any contamination in ground water resulting from releases from a unit at RFETS subject to RCRA interim status requirements will be addressed through this Action Levels and Standards Framework and through remedial actions rather than through RCRA closure (see Attachment 10 to RFCA, RCRA Closure for Interim Status Units). This would include ground water containing nitrates from the Solar Ponds plume. Addressing the nitrates through this Framework will allow these waters to be managed in a more cost-effective and flexible manner.

C. Other Considerations

1. Efficient, cost-effective, and feasible actions that are taken to remediate or manage contaminated ground water may not necessarily be taken at the leading edge of plumes, but rather at a location within the plume. Factors contributing to this situation could include technical impracticability at the plume edge, topographic or ecologic problems at the plume edge, etc. This situation may result in a portion of a plume that will not be remediated or managed. This plume portion may cause exceedance of MCLs at Tier II wells or exceedance of surface water standards/action levels. When an up-gradient ground water action is taken that results in this situation, DOE and its subcontractor may request relief from the ground water and/or surface water standards. CDPHE and EPA will evaluate the request and may grant temporary relief or alternate concentration limits for a specific area. Soil or subsurface soil source removals will not be considered as the sole justification for alternate concentration limits. In addition, alternate concentration limits will be determined such that surface water use classifications are not jeopardized and surface water quality does not exceed standards at points of compliance.
2. Ground water plumes that can be shown to be stationary and do not therefore present a risk to surface water, regardless of their contaminant levels, will not require remediation or management. They will require continued monitoring to demonstrate that they remain stationary.

3.4 Ground Water Monitoring Network

A. The ground water monitoring network will continue to operate as recently modified unless subsequent changes are agreed to by all parties. Analyte suites, sampling frequency, and specific monitoring locations will be evaluated annually to adjust to changing hydrologic conditions including plume migration.

B. All groundwater monitoring data as well as changes in hydrologic conditions and exceedances of groundwater standards will be reported quarterly and summarized annually to all parties.

C. If quarterly reporting shows that previously uncontaminated wells are contaminated above ground water standards, the sampling frequency will be increased to monthly. Three consecutive monthly samples showing exceedances will trigger an evaluation to determine if a remedial or management action is necessary.

D. All ground water plumes that exceed ground water standards must continue to be monitored until the need for institutional controls is mitigated.

E. All ground water remedies, as well as some soil remedies, will require ground water performance monitoring. The amount, frequency, and location of any performance

monitoring will be based on the type of remedy implemented and will be determined on a case-by-case basis within decision documents.

3.5 Ground Water Classifications

A. Three classifications currently apply to ground water at RFETS:
   1. Domestic Use Quality
   2. Agricultural Use Quality
   3. Surface Water Protection

B. Because ground water use in all areas of the Site will be prevented, the domestic use and agricultural use classifications can be removed. Surface water protection standards for ground water are understood to be the applicable surface water standards.

4.0 SUBSURFACE SOIL

4.1 Subsurface soil is defined as soils deeper than six inches below the ground surface. Action levels for subsurface soil are protective of:

A. human exposure appropriate for the land uses delineated on Figure 1,
B. surface water standards via ground water transport, and
C. ecological resources.

4.2 Action Levels: The subsurface soil action levels have been calculated using a two-tier approach.

A. Tier I:

1. All subsurface soils capable of leaching contaminants to groundwater at concentrations greater than or equal to 100 x MCLs. Where an MCL for a particular contaminant is lacking, the residential ground water ingestion-based PPRG value will apply.
2. Contaminant-specific Tier I action levels for volatile organic contaminants have been determined using a soil/water partitioning equation and a dilution factor from EPA's Draft Soil Screening Guidance (1994). These derived values and the parameters used to derive them are listed in Table 4. The subsurface media characteristics for these calculations are based on site-specific data or conservative values where representative site values cannot be determined. Where subsurface characteristics in a particular area within RFETS differ significantly from those chosen as representative of the entire site, those alternate values should be used.
3. Table 4 also includes certain inorganic contaminants that may be of concern at RFETS. Contaminant-specific Tier I action levels for these targeted inorganic contaminants have not yet been included in Table 4, but are currently under development in a manner consistent with the action levels in 4.2.A.1 above. Table 4 will be updated to include these action levels as soon as they are developed.

B. Tier II:

Additional subsurface soil may need to be remediated or managed to protect surface water quality via ground water transport or ecological resources. Subsurface soil presenting unacceptable ecological risks (HI≥1) identified using the approved methodology will be evaluated for remediation or management.

4.3 Action Determinations

A. Tier I: When contaminant levels in subsurface soil exceed Tier I action levels, subsurface soil source removals will be triggered. These removals will be

accomplished through accelerated actions.

B. Tier II: When an action is necessary to protect surface water or ecological resources, a process to identify, evaluate, and implement efficient, cost-effective, and feasible remediation or management actions will be triggered.

1. Actions will be developed in an integrated manner with other actions being taken.
2. Actions will be consistent with best management practices.
3. Actions may be accomplished by means of an interim or final action.
4. Remediation and/or management actions will be implemented to protect ecological resources where those actions can be implemented without damaging other ecological resources.

C. Appropriate remedial or management actions will be determined through this evaluation process on a case-by-case basis, and may include the removal, treatment, disposal, or in-place stabilization of contaminated subsurface soils.

D. Single geographically isolated data points of subsurface soil contamination above the Tier I or Tier II action levels will be evaluated for potential source magnitude. These single points will not necessarily trigger a source removal, remedial, or management action, depending on the source evaluation.

5.0 SURFACE SOIL

5.1 Surface soil will be defined as the upper six inches of soil. Action levels for surface soil are protective of:

A. human exposure appropriate for the land uses delineated on Figure 1,
B. surface water quality via runoff, and
C. ecological resources.

5.2 Action Levels: The surface soil action levels have been calculated using a two-tier approach based on protection of appropriate human exposure.

A. Tier I:

1. Action levels for non-radionuclides are human-health risk-based (carcinogenic risk equal to 10^{-4}) for the appropriate land-use receptor. Table 5 presents the calculated action levels for these exposure scenarios:

a) Industrial Use Area (Area 1 on Fig. 1): Action levels are based on Office Worker exposure as defined in the finalized PPRG document.
b) Restricted Open Space Area (Area 2 and 4 on Fig. 1): Action levels are based on Open Space Recreational User exposure as defined in the finalized PPRG document.

2. Action levels for radionuclides will be the more conservative of:

a) Radiation dose limit of 15 mrem per year for the appropriate land use receptor, or
b) Human-health risk (carcinogenic risk equal to 10^{-4}) to the appropriate land-use receptor as described in Section 5.2.A.1 above. The calculated values associated with these exposure scenarios are listed in Table 5.
c) The parties commit to expeditiously convene a working group to determine the derivation and application of the 15 mrem per year level as well as the derivation and potential application of the 75 mrem per year level.

B. Tier II:

1. Action levels for radionuclides and non-radionuclides are human-health risk-based (carcinogenic risk of 10^{-6} and/or a hazard index of 1) for the appropriate land-use receptor. Table 5 presents the calculated action levels for these exposure scenarios:

a) Industrial Use Area (Area 1 on Fig. 1): Action levels are based on Office Worker exposure as defined in the finalized PPRG document.
b) Restricted Open Space Area (Area 2 and 4 on Figure 1): Action levels are

based on Open Space Recreational User exposure as defined in the finalized PPRG document.

2. Additional surface soil may need to be remediated or managed to protect surface water quality via runoff or ecological resources. The amount of soil and the protective remediation levels and/or management technique will be determined on a case-by-case basis. Subsurface soil presenting unacceptable ecological risks (a hazard index greater than or equal to 1) identified using the approved methodology will be evaluated for remediation or management.

5.3 Action Determinations:

A. Tier I: When contaminant levels in surface soil exceed Tier I action levels a process to identify, evaluate and implement efficient, cost-effective, and feasible remediation or management actions will be triggered. Appropriate remedial or management actions will be determined through this process on a case-by-case basis, and may include the removal, treatment, disposal, or in-place stabilization of contaminated surface soils.

B. Tier II: When contaminant levels in surface soil exceed Tier II action levels, they will be managed. Management may include, but is not limited to, "hotspot" removal, capping, or designating land uses that preclude unacceptable exposure. In addition, if aggregate risks at any source area exceed 10E-4, remedial action will be required.

1. Actions will be developed in an integrated manner with other actions being taken.
2. Actions will be consistent with best management practices.
3. Actions may be accomplished by means of an interim or final action.
4. Remediation and/or management actions will be implemented to protect ecological resources where those actions can be implemented without damaging other ecological resources.

TABLE 6

Recommended Changes Requiring Action by the Colorado Water Quality Control Commission

as a result of the

Action Levels and Standards Framework for Rocky Flats Environmental Technology Site

---

1. Remove Domestic Use and Agricultural Use classifications from groundwater, but leave the Surface Water Protection classification in place.

2. Make the standards that result from the Surface Water Protection classification for ground water equivalent to the surface water standards.

3. Change the nitrate standard on the Walnut Creek portion of Segment 4 to 100 mg/L (which equals the Agricultural Use standard) for the duration of active remediation.

4. Change both the site-specific and the state-wide surface water standards for plutonium and americium from 0.05 pCi/L to 0.15 pCi/L.

5. Develop appropriate site-specific uranium standards.

Figure 1
Conceptual RFETS Land Uses

Explanation of Future Conditions

- Area 3- Unrestricted Open Space (4545 Acres)
- Area 4- Restricted Open Space (Low-level Surficial Pu Contamination) (611 Acres)
- Area 2- Restricted Open Space (799 Acres)
- Area 1- Industrial Use Area (78 Acres)
- Area 0- Capped Areas and Retrievable, Monitored Storage (183 Acres)

Standard Map Features

- Buildings or other structures
- Lakes and ponds
- Fences
- Rocky Flats boundary
- Paved roads
- Dirt roads
- Streams, ditches, or other drainage features

DATA SOURCE:
Buildings, roads, and fences provided by Facilities Dept., EG&G Rocky Flats, Inc. - 1991.
Hydrology provided by USGS - Idaho enhanced

Scale = 1 : 19640
1 inch represents approximately 1636.66 feet

0 1500 3000 Meters

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

MAP ID: a612980 March 07, 1996

Table1 - Surface Water Action Levels & Standards

...yte	CAS No.	Segment 4a & 4b Standards (mg/L)	Basis for Standard	Segment 5 Action Levels (mg/L)	Basis for Action Level	PQLs (a) (mg/L)
Acenaphthene(V)	83-32-9	5.20E-01	AL	2.19E+00	PPRG	1.00E-02
Acenaphthylene(V)	208-96-8	2.80E-06	W+F	2.80E-06	SEG 4	1.00E-02
Acetone(V)	67-64-1	NONE		3.65E+00	PPRG	
Acrolein	107028	2.10E-02	AL	2.10E-02	SEG 4	1.00E-02
Acrylonitrile	107131	5.80E-05	W+F	5.80E-05	SEG 4	5.00E-03
Alachlor	15972608	2.00E-03	WS	2.00E-03	MCL	2.00E-03
Aldicarb	116063	1.00E-02	WS	1.00E-02	SEG 4	1.00E-02
Aldicarb sulfone	1646884	1.00E-03	WS	1.00E-03	SEG 4	3.00E-03
Aldicarb sulfoxide	1646873	4.00E-03	WS	4.00E-03	SEG 4	3.00E-03
Aldrin	309-00-2	1.30E-07	W+F	5.00E-06	PPRG	1.00E-04
Aluminum, dissolved	7429-90-5	8.70E-02	BS	8.70E-02	BS	
Ammonia, unionized	7664417	(b)	(b)	(b)	(b)	
Anthracene(V)	120-12-7	2.80E-06	W+F	1.09E+01	PPRG	1.00E-03
Antimony, total recoverable	7440-36-0	1.40E-02	BS	1.40E-02	BS	
Aroclor-1016	12674-11-2	4.40E-08	W+F	5.00E-04	MCL	1.00E-03
Aroclor-1221	11104-28-2	4.40E-08	W+F	5.00E-04	MCL	1.00E-03
Aroclor-1232	11141-16-5	4.40E-08	W+F	5.00E-04	MCL	1.00E-03
Aroclor-1242	53469-21-9	4.40E-08	W+F	5.00E-04	MCL	1.00E-03
Aroclor-1248	12672-29-6	4.40E-08	W+F	5.00E-04	MCL	1.00E-03
Aroclor-1254	11097-69-1	4.40E-08	W+F	5.00E-04	MCL	1.00E-03
Aroclor-1260	11096-82-5	4.40E-08	W+F	5.00E-04	MCL	1.00E-03
Arsenic, total recoverable	7440-38-2	5.00E-02	SS	5.00E-02	SS	
Atrazine	1912249	3.00E-03	WS	3.00E-03	MCL	1.00E-03
...n, total recoverable	7440-39-3	1.00E+00	BS	1.00E+00	BS	
...ne(V)	71-43-2	1.00E-03	BS	5.00E-03	MCL	1.00E-03
Benzidine	92875	1.20E-07	W+F	1.20E-07	SEG 4	7.00E-03
alpha-BHC	319-84-6	3.90E-06	W+F	1.35E-05	PPRG	5.00E-05
beta-BHC	319-85-7	1.40E-05	W+F	4.72E-05	PPRG	5.00E-05
gamma-BHC (Lindane)	58-89-9	1.90E-05	W+F	2.00E-04	MCL	5.00E-05
Benzo(a)anthracene	56-55-3	2.80E-06	SS	1.16E-04	PPRG	1.00E-02
Benzo(a)pyrene	50-32-8	2.80E-06	SS	2.00E-04	MCL	2.00E-04
Benzo(b)fluoranthene	205-99-2	2.80E-06	SS	2.80E-06	SEG 4	1.00E-02
Benzo(g,h,i)perylene	191-24-2	2.80E-06	SS	2.80E-06	SEG 4	1.00E-02
Benzo(k)fluoranthene	207-08-9	2.80E-06	SS	2.80E-06	SEG 4	1.00E-02
Beryllium, total recoverable	7440-41-7	4.00E-03	SS	4.00E-03	SS	
bis(2-Chloroethoxy)methane(V)	111-91-1	4.00E-03				
bis(2-Chloroethyl)ether(V)	111-44-4	3.00E-05	SS	1.65E-05	PPRG	1.00E-03
bis(2-Chloroisopropyl)ether(V)	108-60-1	1.40E-03	W+F	4.22E-04	PPRG	1.00E-02
bis(chloromethyl)ether	107302	3.70E-09	SS	3.70E-09	SEG 4	
bis(2-Ethylhexyl)phthalate	117-81-7	1.80E-03	W+F	6.00E-03	MCL	1.00E-02
Boron, total	7440428	7.50E-01	SS	7.50E-01	SS	
Bromodichloromethane(V)	75-27-4	1.00E-01	TTHM (c)	1.00E-01	SEG 4	1.00E-03
Bromoform(V)	75-25-2	1.00E-01	TTHM (c)	1.00E-01	SEG 4	1.00E-03
Bromomethane(V)	74-83-9	4.80E-02		1.09E-02	PPRG	1.00E-03
2-Butanone(V)	78-93-3	NONE		2.47E+00	PPRG	
Butylbenzylphthalate	85-68-7	3.00E+00	W+F	3.00E+00	SEG 4	1.00E-02
Cadmium, dissolved	7440-43-9	1.50E-03	SS	1.50E-03	SS	
Carbofuran	1563662	3.60E-02	WS	4.00E-02	MCL	7.00E-03
Carbon disulfide(V)	75-15-0	NONE		2.76E-02	PPRG	
...tetrachloride(V)	56-23-5	2.50E-04	W+F	5.00E-03	MCL	1.00E-03
...ane	5103-71-9	5.80E-07	W+F	2.00E-03	MCL	1.00E-03
Chloride	16887-00-6	2.50E+02	SS	2.50E+02	SEG 4	

Table1 - Surface Water Action Levels & Standards

te	CAS No.	Segment 4a & 4b Standards (mg/L)	Basis for Standard	Segment 5 Action Levels (mg/L)	Basis for Action Level	PQLs (a) (mg/L)
Chlorobenzene(V)	108-90-7	1.00E-01	W+F	1.00E-01	MCL	5.00E-03
Chloroethane(V)	75-00-3	NONE		2.78E+01	PPRG	
Chloroform(V)	67-66-3	1.00E-01	TTHM (c)	1.00E-01	SEG 4	1.00E-03
Chloromethane(V)	74-87-3	5.70E-03	W+F	2.32E-03	PPRG	
4-Chloro-3-methylphenol	59-50-7	3.00E-04	AL	3.00E-04	SEG 4	5.00E-02
2-Chloronaphthalene(V)	91-58-7	6.20E-04	AL	2.92E+00	PPRG	
2-Chlorophenol(V)	95-57-8	2.00E-03	AL	1.82E-01	PPRG	5.00E-02
Chloropyrifos	2921882	4.10E-05	AL	4.10E-05	SEG 4	1.00E-03
Chromium III, Total Recoverable	7440-47-3	5.00E-02	SS	5.00E-02	SS	
Chromium VI, dissolved	7440-47-3	1.10E-02	SS	1.10E-02	SS	
Chrysene	218-01-9	2.80E-06	W+F	1.16E-02	PPRG	1.00E-02
Copper, dissolved	7440-50-8	1.60E-02	SS	1.60E-02	SS	
Cyanide	57-12-5	5.00E-03	SS	5.00E-03	SS	
4,4-DDD	72-54-8	8.30E-07	W+F	3.54E-04	PPRG	1.00E-04
4,4-DDE	72-55-9	5.90E-07	W+F	2.50E-04	PPRG	1.00E-04
4,4-DDT	50-29-3	5.90E-07	W+F	2.50E-04	PPRG	1.00E-04
Dalapon	75-99-0	2.00E-01	WS	2.00E-01	MCL	1.30E-02
Demeton	8065483	1.00E-04	AL	1.00E-04	SEG 4	
Dibenzo(a,h)anthracene	53-70-3	2.80E-06	W+F	1.16E-05	PPRG	1.00E-02
Dibromochloromethane	124-48-1	1.00E-01	TTHM (c)	1.01E-03	PPRG	1.00E-03
1,2-Dibromo-3-chloropropane	96-12-8	2.00E-04	WS	2.00E-04	MCL	5.00E-05
Di-n-butylphthalate	84-74-0	2.70E-03	W+F	3.65E+00	PPRG	1.00E-02
2,4-D	94-75-7	7.00E-02	WS	7.00E-02	MCL	1.00E-03
·-Dichlorobenzene(V)	95-50-1	6.20E-01	W+F, WS	6.00E-01	MCL	1.00E-03
chlorobenzene(V)	541-73-1	4.00E-01	W+F	6.00E-01	MCL	1.00E-03
1,4-Dichlorobenzene(V)	106-46-7	7.50E-02	W+F, WS	7.50E-02	MCL	1.00E-03
3,3-Dichlorobenzidine	91-94-1	3.90E-05	W+F	1.89E-04	PPRG	1.00E-02
1,1-Dichloroethane(V)	107-06-2	NONE		1.01E+00	PPRG	1.00E-03
1,2-Dichloroethane(V)	107-06-2	4.00E-04	W+F	5.00E-03	MCL	1.00E-03
1,1-Dichloroethene(V)	540-59-0	5.70E-05	W+F	7.00E-03	MCL	1.00E-03
1,2-Dichloroethene (total)(V)	540-59-0	7.00E-03	WS	7.00E-02	MCL	1.00E-03
2,4-Dichlorophenol	120-83-2	2.10E-02	W+F	1.10E-01	PPRG	5.00E-02
1,2-Dichloropropane(V)	78-87-5	5.60E-04	W+F	5.00E-03	MCL	1.00E-03
cis-1,3-Dichloropropene(V)	1006-01-5	NONE		1.27E-04	PPRG	1.00E-03
trans-1,3-Dichloropropene(V)	10061-02-6	NONE		1.27E-04	PPRG	1.00E-03
1,3-Dichloropropylene	542756	1.00E-02	W+F	1.00E-02	SEG 4	
Dieldrin	60-57-1	1.40E-07	W+F	5.31E-06	PPRG	1.00E-04
Di(2-ethylhexyl)adipate	103231	4.00E-01	WS	4.00E-01	MCL	6.00E-03
Di(2-ethylhexyl)phthalate	117817	6.00E-03	WS	6.00E-03	MCL	6.00E-03
Diethylphthalate	84-66-2	2.30E+01	W+F	2.92E+01	PPRG	1.00E-02
Diisopropyl methyl phosphonate	1445756	8.00E-03	WS	8.00E-03	SEG 4	1.00E-03
2,4-Dimethylphenol(V)	105-67-9	5.40E-01	W+F	7.30E-01	PPRG	5.00E-02
Dimethylphthalate	131-11-3	3.13E+02	W+F	3.65E+02	PPRG	1.00E-02
4,6-Dinitro-2-methylphenol(V)	534-52-1	1.30E-02	W+F	1.30E-02	SEG 4	
2,4-Dinitrophenol	51-28-5	1.40E-02	W+F, WS	7.30E-02	PPRG	5.00E-02
2,4-Dinitrotoluene	121-14-2	1.10E-03	W+F	7.30E-02	PPRG	1.00E-02
2,6-Dinitrotoluene	606-20-2	2.30E-01	W+F	1.25E-04	PPRG	1.00E-02
Dinoseb	88857	7.00E-03	WS	7.00E-03	MCL	2.00E-03
Dioxin	1746016	1.30E-11	W+F	3.00E-08	MCL	
phenylhydrazine	122667	4.00E-05	W+F	4.00E-05	SEG 4	
	65007	2.00E-02	WS	2.00E-02	MCL	4.00E-03
Endosulfan I	959-98-8	5.60E-05	AL	2.19E-01	PPRG	1.00E-04

Table1 - Surface Water Action Levels & Standards

yte	CAS No.	Segment 4a & 4b Standards (mg/L)	Basis for Standard	Segment 6 Action Levels (mg/L)	Basis for Action Level	PQLs (a) (mg/L)
Endosulfan II	33213-65-9	5.60E-05	AL	5.60E-05	SEG 4	1.00E-04
Endosulfan sulfate	1031-07-8	1.10E-01	W+F	2.19E-01	PPRG	1.00E-04
Endothall	145733	1.00E-01	WS	1.00E-01	MCL	9.00E-02
Endrin (technical)	72-26-8	2.30E-06		2.00E-03	MCL	1.00E-04
Endrin aldehyde	7421934	2.00E-04	W+F,WS	2.00E-04	SEG 4	1.00E-04
Ethylbenzene(V)	100-41-4	6.80E-01	W+F	7.00E-01	MCL	1.00E-02
Ethylene dibromide	106934	5.00E-05	WS	5.00E-05	MCL	
Fluoranthene	206-44-0	4.20E-02	SS	1.46E+00	PPRG	1.00E-02
Fluorene(V)	86-73-7	2.80E-06	SS	1.46E+00	PPRG	1.00E-02
Fluoride	16984-48-8	2.00E+00	BS	2.00E+00	SEG 4	
Glyphosate	1071-83-6	7.00E-01		7.00E-01	MCL	6.00E-02
Guthion	86500	1.00E-05	AL	1.00E-05	SEG 4	1.50E-03
Heptachlor	76-44-8	2.10E-07	W+F	4.00E-04	MCL	5.00E-05
Heptachlor epoxide	1024-57-3	1.00E-07	W+F	2.00E-04	MCL	5.00E-05
Hexachlorobenzene	118-74-1	7.50E-07	W+F	1.00E-03	MCL	1.00E-03
Hexachlorobutadiene	87-68-3	1.90E-03	W+F	1.90E-03	PPRG	1.00E-02
Hexachlorocyclohexane, Technical	608731	2.80E-06	W+F	2.80E-06	SEG 4	2.00E-04
Hexachlorocyclopentadiene	77-47-4	5.00E-02	AL	5.00E-02	MCL	1.00E-03
Hexachloroethane	67-72-1	1.90E-03	W+F	6.70E-03	PPRG	1.00E-02
Indeno(1,2,3-cd)pyrene	193-39-5	2.80E-06		1.16E-04	PPRG	1.00E-02
Iron, dissolved	7439-89-6	3.00E-01	SS	3.00E-01	SS	
Iron, total recoverable	7439-89-6	1.00E+00	SS	1.00E+00	SS	
Isophorone	78-59-1	3.60E-02	W+F	8.95E-02	PPRG	1.00E-02
·d, dissolved	7439-92-1	6.50E-03	SS	6.50E+00	SS	
ıion	121754	1.00E-04	AL	1.00E-04	SEG 4	2.00E-04
ıganese, dissolved	7439-96-5	5.00E-02	SS	5.00E-02	SS	
Manganese, total recoverable	7439-96-5	1.00E+00	SS	1.00E+00	SS	
Mercury, total	7439-97-6	1.00E-05	SS	1.00E-05	SS	
Methoxychlor	72-43-5	3.00E-05	W+F	4.00E-02	MCL	5.00E-04
Methylene chloride(V)	75-09-2	5.00E-03	W+F, WS	5.00E-03	MCL	
4-Methyl-2-pentanone(V)	108-10-1	NONE		2.03E-01	PPRG	
2-Methylphenol	95-48-7	NONE		1.83E+00	PPRG	
Mirex	2385855	1.00E-06	AL	1.00E-06	SEG 4	1.00E-04
Naphthalene(V)	91-20-3	2.80E-07	SS	1.46E+00	PPRG	1.00E-02
Nickel, dissolved	7440-02-0	1.23E-01	SS	1.23E-01	SS	
Nitrate	14797558	1.00E+01	SS (d)	1.00E+01	SS (d)	
Nitrite	14797650	5.00E-01	SS	5.00E-01	SS	
Nitrobenzene(V)	98-95-3	3.50E-03	W+F, WS	4.20E-03	PPRG	1.00E-02
Nitrosodibutylamine N		6.40E-06	W+F	6.40E-06	SEG 4	1.00E-02
Nitrosodiethylamine N		8.00E-07	W+F	8.00E-07	SEG 4	1.00E-02
Nitrosodimethylamine N	62759	6.90E-07	W+F	6.90E-07	SEG 4	1.00E-02
n-Nitrosodiphenylamine(V)	86-30-6	4.00E-03	W+F	1.73E-02	PPRG	1.00E-02
n-Nitrosodipropylamine	621-64-7	5.00E-06	W+F	1.21E-05	PPRG	1.00E-02
Nitrosopyrrolidine N		1.60E-05	W+F	1.60E-05	SEG 4	1.00E-02
Oxamyl(vydate)	23135220	2.00E-01	WS	2.00E-01	MCL	2.00E-02
Parathion	56382	4.00E-04	SS	4.00E-04	SEG 4	
Pentachlorobenzene	608935	6.00E-03	WS	6.00E-03	SEG 4	1.00E-02
Pentachlorophenol	87-86-5	2.80E-04	W+F	1.00E-03	MCL	1.00E-03
Phenanthrene(V)	85-01-8	2.80E-06	W+F	2.80E-06	SEG 4	1.00E-02
ol	108-95-2	2.56E+00	AL	2.19E+01	PPRG	5.00E-02
·am	1918021	5.00E-01	WS	5.00E-01	MCL	1.00E-03
Pyrene	129-00-0	2.80E-06	SS	1.10E+00	PPRG	1.00E-02

Table1 - Surface Water Action Levels & Standards

...ce	CAS No.	Segment 4a & 4b Standards (mg/L)	Basis for Standard	Segment 5 Action Levels (mg/L)	Basis for Action Level	PQLs (a) (mg/L)
Selenium, Total Recoverable	7782-49-2	1.00E-02	SS	1.00E-02	SS	
Silver, dissolved	7440-22-4	6.00E-04	SS	6.00E-04	SS	
Simazine	122349	4.00E-03	WS	4.00E-03	MCL	7.00E-04
Sulfate	14808-79-8	2.50E+02	SS	2.50E+02	SEG 4	
Sulfide	18496258	2.00E-02	SS	2.00E-02	SS	
Styrene(V)	100-42-5	1.00E-01	WS	1.00E-01	MCL	
1,2,4,5-Tetrachlorobenzene	95953	2.00E-03	WS	2.00E-03	SEG 4	1.00E-02
1,1,2,2-Tetrachloroethane(V)	79-34-5	1.70E-04	W+F	8.95E-05	PPRG	**1.00E-03**
Tetrachloroethene(V)	127-18-4	8.00E-04	W+F	5.00E-03	MCL	**1.00E-03**
Toluene(V)	108-88-3	1.00E+00	W+F, WS	1.00E+00	MCL	5.00E-03
Toxaphene	8001-35-2	2.00E-07	AL	3.00E-03	MCL	**3.00E-03**
1,2,4-Trichlorobenzene(V)	120-82-1	5.00E-02	AL	7.00E-02	MCL	5.00E-03
1,1,1-Trichloroethane(V)	71-55-6	2.00E-01	W+F, WS	2.00E-01	MCL	5.00E-03
1,1,2-Trichloroethane(V)	79-00-5	6.00E-04	W+F	5.00E-03	MCL	**1.00E-03**
Trichloroethene(V)	79-01-6	2.70E-03	W+F	5.00E-03	MCL	1.00E-03
2,4,6-Trichlorophenol	88-06-2	2.00E-03	W+F, WS	7.73E-03	PPRG	**5.00E-02**
Trichlorophenoxyproprionic acid	93721	5.00E-02	WS	5.00E-02	SEG 4	5.00E-03
Vinyl chloride(V)	75-01-4	2.00E-03	W+F, WS	2.00E-03	MCL	2.00E-03
Xylene (total)(V)	1330-20-7	1.00E+01	WS	1.00E+01	MCL	5.00E-03
Zinc, dissolved	7440-66-6	1.41E-01	SS	1.41E-01	SS	
RADIOLOGIC PARAMETERS		**Woman Creek (pCi/L)**		**Walnut Creek (pCi/L)**		
A...icium 241, total	14596102	1.50E-01	SS	1.50E-01	SS	
...um 239 and 240, total	10128	1.50E-01	SS	1.50E-01	SS	
...m 226 and 228, total	13982633	5.00E+00	BS	5.00E+00	BS	
Strontium 90, total	11109	8.00E+00	BS	8.00E+00	BS	
Tritium	10028178	5.00E+02	SS	5.00E+02	SS	
Uranium, total	7440611	5.00E+00	SS	1.00E+01	SS	
Gross Alpha, total	14127629	7.00E+00	SS	1.10E+01	SS	
Gross Beta, total	12587472	5.00E+00	SS	1.90E+01	SS	

(a) Whenever the practical quantitation level (PQL) for a pollutant is higher (less stringent) than a standard/action level, "less than" the PQL shall be used as the compliance threshold. These less stringent PQLs are bolded.

(b) There is no unionized ammonia standard for Segment 5 or Segment 4b. A standard of 0.1 ug/L applies to Segment 4a which begins at Walnut Ck at Indiana.

(c) Per the Basic Standards, the TTHM standard applies to the sum of the four TTHM (Total Trihalomethane) compounds.

(d) The Action Levels & Standards Framework anticipates that this value will be changed to 100 mg/L.

BS = Basic Standard; SS = Site Specific Standard; WS = Water Supply; W+F = Water plus Fish;

MCL = Maximum Contaminant Level; AL = Aquatic Life; PPRG = Preliminary Programmatic Remediation Goal;

SEG 4 = organic value set equal to the Segment 4 standard where MCL and PPRG are lacking; (V) = volatile chemical;

Metals standards, when based on a toxicity equation, use a hardness value of 143 mg/L

Table 2 - Ground Water Action Levels

Analyte	CAS No.	Tier 1- 100 x MCLs (mg/L)	Tier 2- MCLs (mg/L)
Acenaphthene(V)	83-32-9	***2.19E+02***	***2.19E+00***
Acetone(V)	67-64-1	***3.65E+02***	***3.65E+00***
Aldrin	309-00-2	***5.00E-04***	***5.00E-06***
Aluminum	7429-90-5	***1.06E+04***	***1.06E+02***
Anthracene(V)	120-12-7	***1.10E+03***	***1.10E+01***
Antimony	7440-36-0	6.00E-01	6.00E-03
Aroclor-1016	12674-11-2	5.00E-02	5.00E-04
Aroclor-1221	11104-28-2	5.00E-02	5.00E-04
Aroclor-1232	11141-16-5	5.00E-02	5.00E-04
Aroclor-1242	53469-21-9	5.00E-02	5.00E-04
Aroclor-1248	12672-29-6	5.00E-02	5.00E-04
Aroclor-1254	11097-69-1	5.00E-02	5.00E-04
Aroclor-1260	11096-82-5	5.00E-02	5.00E-04
Arsenic	7440-38-2	5.00E+00	5.00E-02
Barium	7440-39-3	2.00E+02	2.00E+00
Benzene(V)	71-43-2	5.00E-01	5.00E-03
alpha-BHC	319-84-6	***1.35E-03***	***1.35E-05***
beta-BHC	319-85-7	***4.72E-03***	***4.72E-05***
gamma-BHC (Lindane)	58-89-9	2.00E-02	2.00E-04
Benzo(a)anthracene	56-55-3	***1.16E-02***	***1.16E-04***
Benzo(a)pyrene	50-32-8	2.00E-02	2.00E-04
Benzo(b)fluoranthene	205-99-2	***1.16E-02***	***1.16E-04***
Benzo(k)fluoranthene	207-08-9	***1.16E-01***	***1.16E-03***
Benzoic Acid	65-85-0	***1.46E+04***	***1.46E+02***
Benzyl Alcohol	100-51-6	***1.10E+03***	***1.10E+01***
Beryllium	7440-41-7	4.00E-01	4.00E-03
bis(2-Chloroethyl)ether(V)	111-44-4	***1.63E-03***	***1.63E-05***
bis(2-Chloroisopropyl)ether(V)	108-60-1	***4.22E-02***	***4.22E-04***
bis(2-Ethylhexyl)phthalate	117-81-7	6.00E-01	6.00E-03
Bromodichloromethane(V)	75-27-4	1.00E+01	1.00E-01
Bromoform(V)	75-25-2	1.00E+01	1.00E-01
Bromomethane(V)	74-83-9	***1.09E+00***	***1.09E-02***
2-Butanone(V)	78-93-3	***2.47E+02***	***2.47E+00***
Butylbenzylphthalate	85-68-7	***7.30E+02***	***7.30E+00***
Cadmium	7440-43-9	5.00E-01	5.00E-03
Carbon disulfide(V)	75-15-0	***2.76E+00***	***2.76E-02***
Carbon tetrachloride(V)	56-23-5	5.00E-01	5.00E-03
alpha-Chlordane	5103-71-9	2.00E-01	2.00E-03
beta-Chlordane	5103-74-2	2.00E-01	2.00E-03
gamma-Chlordane	5103-74-2	2.00E-01	2.00E-03
4-Chloroaniline	106-47-8	***1.46E+01***	***1.46E-01***
Chlorobenzene(V)	108-90-7	1.00E+01	1.00E-01
Chloroethane(V)	75-00-3	***2.78E+03***	***2.78E+01***
Chloroform(V)	67-66-3	1.00E+01	1.00E-01
Chloromethane(V)	74-87-3	***2.32E-01***	***2.32E-03***
2-Chloronaphthalene(V)	91-58-7	***2.92E+02***	***2.92E+00***
2-Chlorophenol(V)	95-57-8	***1.83E+01***	***1.83E-01***
Chromium	7440-47-3	1.00E+01	1.00E-01
Chrysene	218-01-9	***1.16E+00***	***1.16E-02***
Cobalt	7440-48-4	***2.19E+02***	***2.19E+00***

Analyte	CAS No.	Tier 1- 100 x MCLs (mg/L)	Tier 2- MCLs (mg/L)
Copper	7440-50-8	1.30E+02	1.30E+00
Cyanide	57-12-5	2.00E+01	2.00E-01
4,4-DDD	72-54-8	*3.54E-02*	*3.54E-04*
4,4-DDE	72-55-9	*2.50E-02*	*2.50E-04*
4,4-DDT	50-29-3	*2.50E-02*	*2.50E-04*
Dalapon	75-99-0	2.00E+01	2.00E-01
Dibenz(a,h)anthracene	53-70-3	*1.16E-03*	*1.16E-05*
Dibromochloromethane	124-48-1	*1.01E-01*	*1.01E-03*
1,2-Dibromo-3-chloropropane	96-12-8	2.00E-02	2.00E-04
Di-n-butylphthalate	84-74-0	*3.65E+02*	*3.65E+00*
2,4-D	94-75-7	7.00E+00	7.00E-02
1,2-Dichlorobenzene(V)	95-50-1	6.00E+01	6.00E-01
1,3-Dichlorobenzene(V)	541-73-1	6.00E+01	6.00E-01
1,4-Dichlorobenzene(V)	106-46-7	7.50E+00	7.50E-02
3,3-Dichlorobenzidine	91-94-1	*1.89E-02*	*1.89E-04*
1,1-Dichloroethane(V)	107-06-2	*1.01E+02*	*1.01E+00*
1,2-Dichloroethane(V)	107-06-2	5.00E-01	5.00E-03
1,1-Dichloroethene(V)	540-59-0	7.00E-01	7.00E-03
1,2-Dichloroethene (total)(V)	540-59-0	7.00E+00	7.00E-02
2,4-Dichlorophenol	120-83-2	*1.10E+01*	*1.10E-01*
1,2-Dichloropropane(V)	78-87-5	5.00E-01	5.00E-03
cis-1,3-Dichloropropene(V)	1006-01-5	*1.27E-02*	*1.27E-04*
trans-1,3-Dichloropropene(V)	10061-02-6	*1.27E-02*	*1.27E-04*
Dieldrin	60-57-1	*5.31E-04*	*5.31E-06*
Diethylphthalate	84-66-2	*2.92E+03*	*2.92E+01*
2,4-Dimethylphenol(V)	105-67-9	*7.30E+01*	*7.30E-01*
Dimethylphthalate	131-11-3	*3.65E+04*	*3.65E+02*
2,4-Dinitrophenol	51-28-5	*7.30E+00*	*7.30E-02*
2,4-Dinitrotoluene	121-14-2	*7.30E+00*	*7.30E-02*
2,6-Dinitrotoluene	606-20-2	*1.25E-02*	*1.25E-04*
Di-n-octylphthalate	117-84-0	*7.30E+01*	*7.30E-01*
Endosulfan I	959-98-8	*2.19E+01*	*2.19E-01*
Endosulfan II	33213-65-9	*2.19E+01*	*2.19E-01*
Endosulfan sulfate	1031-07-8	*2.19E+01*	*2.19E-01*
Endosulfan (technical)	115-29-7	*2.19E+01*	*2.19E-01*
Endrin (technical)	72-26-8	2.00E-01	2.00E-03
Ethylbenzene(V)	100-41-4	7.00E+01	7.00E-01
Fluoranthene	206-44-0	*1.46E+02*	*1.46E+00*
Fluorene(V)	86-73-7	*1.46E+02*	*1.46E+00*
Fluoride	16984-48-8	4.00E+02	4.00E+00
Glyphosate	1071-83-6	7.00E+01	7.00E-01
Heptachlor	76-44-8	4.00E-02	4.00E-04
Heptachlor epoxide	1024-57-3	2.00E-02	2.00E-04
Hexachlorobenzene	118-74-1	1.00E-01	1.00E-03
Hexachlorobutadiene	87-68-3	*1.09E-01*	*1.09E-03*
Hexachlorocyclopentadiene	77-47-4	5.00E+00	5.00E-02
Hexachloroethane	67-72-1	*6.07E-01*	*6.07E-03*
Indeno(1,2,3-cd)pyrene	193-39-5	*1.16E-02*	*1.16E-04*
Isophorone	78-59-1	*8.95E+00*	*8.95E-02*
Lithium	7439-93-2	*7.30E+01*	*7.30E-01*

Analyte	CAS No.	Tier 1- 100 x MCLs (mg/L)	Tier 2- MCLs (mg/L)
Manganese	7439-96-5	***1.83E+01***	***1.83E-01***
Mercury	7439-97-6	2.00E-01	2.00E-03
Methoxychlor	72-43-5	4.00E+00	4.00E-02
Methylene chloride(V)	75-09-2	5.00E-01	5.00E-03
4-Methyl-2-pentanone(V)	108-10-1	***2.03E+01***	***2.03E-01***
2-Methylphenol	95-48-7	***1.83E+02***	***1.83E+00***
Molybdenum	7439-98-7	***1.83E+01***	***1.83E-01***
Naphthalene(V)	91-20-3	***1.46E+02***	***1.46E+00***
Nickel	7440-02-0	1.00E+01	1.00E-01
Nitrate (MCL as N)	1-005	1.00E+03	1.00E+01
Nitrite (MCL as N)	1-005	1.00E+02	1.00E+00
Nitrobenzene(V)	98-95-3	***4.20E-01***	***4.20E-03***
n-Nitrosodiphenylamine(V)	86-30-6	***1.73E+00***	***1.73E-02***
n-Nitrosodipropylamine	621-64-7	***1.21E-03***	***1.21E-05***
Pentachlorophenol	87-86-5	1.00E-01	1.00E-03
Phenol	108-95-2	***2.19E+03***	***2.19E+01***
Pyrene	129-00-0	***1.10E+02***	***1.10E+00***
Selenium	7782-49-2	5.00E+00	5.00E-02
Silver	7440-22-4	***1.83E+01***	***1.83E-01***
Strontium	7440-24-6	***2.19E+03***	***2.19E+01***
Styrene(V)	100-42-5	1.00E+01	1.00E-01
Sulfate	14808-79-8	5.00E+04*	5.00E+02*
1,1,2,2-Tetrachloroethane(V)	79-34-5	***8.95E-03***	***8.95E-05***
Tetrachloroethene(V)	127-18-4	5.00E-01	5.00E-03
Thallium	7440-28-0	2.00E-01	2.00E-03
Tin	7440-31-5	***2.19E+03***	***2.19E+01***
Toluene(V)	108-88-3	1.00E+02	1.00E+00
Toxaphene	8001-35-2	3.00E-01	3.00E-03
1,2,4-Trichlorobenzene(V)	120-82-1	7.00E+00	7.00E-02
1,1,1-Trichloroethane(V)	71-55-6	2.00E+01	2.00E-01
1,1,2-Trichloroethane(V)	79-00-5	5.00E-01	5.00E-03
Trichloroethene(V)	79-01-6	5.00E-01	5.00E-03
2,4,5-Trichlorophenol	95-95-4	5.00E+00	5.00E-02
2,4,6-Trichlorophenol	88-06-2	***7.73E-01***	***7.73E-03***
Vanadium	7440-62-2	***2.56E+01***	***2.56E-01***
Vinyl acetate	108-05-4	***3.65E+03***	***3.65E+01***
Vinyl chloride(V)	75-01-4	2.00E-01	2.00E-03
Xylene (total)(V)	1330-20-7	1.00E+03	1.00E+01
Zinc	7440-66-6	***1.10E+03***	***1.10E+01***

Analytes without an MCL value list the corresponding residential ground water ingestion Preliminary Programmatic Remediation Goal (PPRG) which is shown in bold italics.

Analytes without an MCL or a PPRG value are not listed.

(V) = Chemicals listed are volatiles

* Based on proposed MCL

Analyte	CAS No.	Tier 1- 100 x MCLs (pCi/L)	Tier 2- MCLs (pCi/L)
RADIOLOGIC PARAMETERS:			
Americium-241	14596-10-2	*1.45E+01*	*1.45E-01*
Cesium-137+D	10045-97-3	*1.51E+02*	*1.51E+00*
Plutonium-239	10-12-8	*1.51E+01*	*1.51E-01*
Plutonium-240	10-12-8	*1.51E+01*	*1.51E-01*
Radium-226+D	13982-63-3	2.00E+03*	2.00E+01*
Radium-228+D	15262-20-1	2.00E+03*	2.00E+01*
Strontium-89	11-10-9	*4.62E+02*	*4.62E+00*
Strontium-90+D	11-10-9	*8.52E+01*	*8.52E-01*
Tritium	10028-17-8	*6.66E+04*	*6.66E+02*
Uranium-233+D	11-08-5	*2.98E+02*	*2.98E+00*
Uranium-234	11-08-5	*1.07E+02*	*1.07E+00*
Uranium-235+D	15117-96-1	*1.01E+02*	*1.01E+00*
Uranium-238+D	7440-61-1	*7.68E+01*	*7.68E-01*

D = Daughters

* Based on proposed MCL

Table 3 - Tier II Ground Water Monitoring Wells for Volatile Organic Compounds

Location Code	
6586	
75992	
06091	
10194	
1986	
10994	
P314289	
P313589	
7086	
10992	
1786	
1386	
10692	
4087	
B206989	
New well	(upstream of 6586)
New well	(between ponds B-2 and B-3)
New well	(downgradient of Ryan's Pit near pond C-1)

Table 4 - Tier I Subsurface Soil Action Levels

Analyte	CAS No.	Henry's Constant	Kd	Dilution Factor	Calculated Leachability at Tier I Ground Water Action Levels (mg/L)
Acenaphthene(V)	83-32-9	7.54E-03	14.21	7.8	***2.47E+04***
Acetone(V)	67-64-1	1.18E-03	0.80	7.8	***2.74E+03***
Aldrin	309-00-2	4.22E-03	114.25	7.8	***4.48E-01***
Aluminum	7429-90-5			7.8	***TBD***
Anthracene(V)	120-12-7	4.55E-03	8.81	7.8	***7.73E+04***
Antimony	7440-36-0			7.8	TBD
Aroclor-1016	12674-11-2	1.07E-03	241.87	7.8	9.48E+01
Aroclor-1221	11104-28-2	1.07E-03	1173.39	7.8	4.59E+02
Aroclor-1232	11141-16-5	1.07E-03	1173.39	7.8	4.59E+02
Aroclor-1242	53469-21-9	1.07E-03	1173.39	7.8	4.59E+02
Aroclor-1248	12672-29-6	1.07E-03	1173.39	7.8	4.59E+02
Aroclor-1254	11097-69-1	1.07E-03	1790.01	7.8	7.01E+02
Aroclor-1260	11096-82-5	1.07E-03	9746.45	7.8	3.82E+03
Arsenic	7440-38-2			7.8	TBD
Barium	7440-39-3			7.8	TBD
Benzene(V)	71-43-2	2.24E-01	1.88	7.8	8.08E+00
alpha-BHC	319-84-6	2.78E-04	7.11	7.8	***7.69E-02***
beta-BHC	319-85-7	1.42E-05	8.28	7.8	***3.12E-01***
gamma-BHC (Lindane)	58-89-9	1.39E-04	6.15	7.8	1.07E+00
Benzo(a)anthracene	56-55-3	1.48E-04	791.73	7.8	***7.19E+01***
Benzo(a)pyrene	50-32-8	3.43E-05	2022.64	7.8	3.17E+02
Benzo(b)fluoranthene	205-99-2	2.53E-04	1949.54	7.8	***1.77E+02***
Benzo(k)fluoranthene	207-08-9	3.94E-05	1217.44	7.8	***1.11E+03***
Benzoic Acid	65-85-0			7.8	***TBD***
Benzyl Alcohol	100-51-6			7.8	***TBD***
Beryllium	7440-41-7			7.8	TBD
bis(2-Chloroethyl)ether(V)	111-44-4	8.77E-04	1.46	7.8	***2.06E-02***
bis(2-Chloroisopropyl)ether(V)	108-60-1	1.13E-04	1.05	7.8	***4.01E-01***
bis(2-Ethylhexyl)phthalate	117-81-7	3.43E-04	197.76	7.8	9.32E+02
Bromodichloromethane(V)	75-27-4	1.30E-01	1.80	7.8	1.96E+02
Bromoform(V)	75-25-2	2.52E-02	1.59	7.8	1.79E+02
Bromomethane(V)	74-83-9	5.82E-01	1.22	7.8	***1.24E+01***
2-Butanone(V)	78-93-3			7.8	***TBD***
Butylbenzylphthalate	85-68-7	7.83E-05	79.05	7.8	***4.53E+05***
Cadmium	7440-43-9			7.8	TBD
Carbon disulfide(V)	75-15-0	5.21E-01	1.78	7.8	***4.32E+01***
Carbon tetrachloride(V)	56-23-5	1.18E+00	2.53	7.8	1.10E+01
alpha-Chlordane	5103-71-9	2.73E-03	120.00	7.8	1.89E+02
beta-Chlordane	5103-74-2	2.73E-03	120.00	7.8	1.89E+02
gamma-Chlordane	5103-74-2	2.73E-03	120.00	7.8	1.89E+02
4-Chloroaniline	106-47-8	4.80E-05	1.68	7.8	***2.10E+02***
Chlorobenzene(V)	108-90-7	4.80E-05	2.68	7.8	2.64E+02
Chloroethane(V)	75-00-3	8.48E-03	1.42	7.8	***3.45E+04***
Chloroform(V)	67-66-3	1.65E-01	1.76	7.8	1.52E+02
Chloromethane(V)	74-87-3	9.72E-02	1.13	7.8	***2.36E+00***
2-Chloronaphthalene(V)	91-58-7			7.8	***TBD***
2-Chlorophenol(V)	95-57-8	1.30E-05	1.18	7.8	***2.82E+02***
Chromium	7440-47-3			7.8	TBD
Chrysene	218-01-9	4.96E-05	693.95	7.8	***6.30E+03***
Cobalt	7440-48-4			7.8	***TBD***

Analyte	CAS No.	Henry's Constant	Kd	Dilution Factor	Calculated Leachability at Tier I Ground Water Action Levels (mg/L)
Copper	7440-50-8			7.8	TBD
Cyanide	57-12-5			7.8	TBD
4,4-DDD	72-54-8	7.96E-06	1701.84	7.8	***4.72E+02***
4,4-DDE	72-55-9	6.80E-05	9690.52	7.8	***1.90E+03***
4,4-DDT	50-29-3	5.13E-04	542.41	7.8	***1.06E+02***
Dalapon	75-99-0			7.8	TBD
Dibenzo(a,h)anthracene	53-70-3	4.59E-07	3979.74	7.8	***3.61E+01***
Dibromochloromethane	124-48-1			7.8	***TBD***
1,2-Dibromo-3-chloropropane	96-12-8			7.8	TBD
Di-n-butylphthalate	84-74-0	5.86E-05	7.54	7.8	***2.20E+03***
2,4-D	94-75-7			7.8	TBD
1,2-Dichlorobenzene(V)	95-50-1	8.61E-02	3.67	7.8	2.05E+03
1,3-Dichlorobenzene(V)	541-73-1			7.8	TBD
1,4-Dichlorobenzene(V)	106-46-7	1.15E-01	3.94	7.8	2.72E+02
3,3-Dichlorobenzidine	91-94-1	8.53E-07	8.35	7.8	***1.26E+00***
1,1-Dichloroethane(V)	107-06-2	7.54E-03	1.66	7.8	***1.44E+03***
1,2-Dichloroethane(V)	107-06-2	5.25E-02	1.45	7.8	6.33E+00
1,1-Dichloroethene(V)	540-59-0	1.04E+00	1.89	7.8	1.19E+01
1,2-Dichloroethene (total)(V)	540-59-0	2.29E-01	1.55	7.8	9.51E+00
2,4-Dichlorophenol	120-83-2	2.75E-06	3.16	7.8	***2.86E+02***
1,2-Dichloropropane(V)	78-87-5	1.15E-01	1.82	7.8	9.83E+00
cis-1,3-Dichloropropene(V)	1006-01-5	1.21E-01	1.58	7.8	***1.74E-01***
trans-1,3-Dichloropropene(V)	10061-02-6	1.21E-01	1.58	7.8	***1.74E-01***
Dieldrin	60-57-1	1.09E-04	29.44	7.8	***1.20E-01***
Diethylphthalate	84-66-2	2.24E-05	2.07	7.8	***5.10E+04***
2,4-Dimethylphenol(V)	105-67-9	6.00E-07	1.59	7.8	***1.00E+03***
Dimethylphthalate	131-11-3	2.37E-05	1.56	7.8	***4.91E+05***
2,4-Dinitrophenol	51-28-5	6.45E-10	1.42	7.8	***9.05E+01***
2,4-Dinitrotoluene	121-14-2	6.03E-06	1.78	7.8	***1.11E+02***
2,6-Dinitrotoluene	606-20-2	5.33E-06	1.69	7.8	***1.81E-01***
Di-n-octylphthalate	117-84-0	3.14E-05	2156204.19	7.8	***1.23E+09***
Endosulfan I	959-98-8	9.47E-04	4.50	7.8	***7.99E+02***
Endosulfan II	33213-65-9	9.47E-04	4.50	7.8	***7.99E+02***
Endosulfan sulfate	1031-07-8			7.8	***TBD***
Endosulfan (technical)	115-29-7	9.47E-04	4.50	7.8	***7.99E+02***
Endrin (technical)	72-26-8	4.88E-05	3.01	7.8	5.80E+00
Ethylbenzene(V)	100-41-4	3.18E-01	3.01	7.8	1.76E+03
Fluoranthene	206-44-0	3.83E-04	113.21	7.8	***1.30E+05***
Fluorene(V)	86-73-7	2.99E-03	21.22	7.8	***5.44E+04***
Fluoride	16984-48-8			7.8	TBD
Glyphosate	1071-83-6			7.8	TBD
Heptachlor	76-44-8	2.41E-02	20.05	7.8	6.50E+00
Heptachlor epoxide	1024-57-3	3.40E-04	20.51	7.8	3.32E+00
Hexachlorobenzene	118-74-1	2.19E-02	88.56	7.8	6.99E+01
Hexachlorobutadiene	87-68-3	9.80E-01	19.94	7.8	***1.73E+01***
Hexachlorocyclopentadiene	77-47-4	7.05E-01	25.96	7.8	1.04E+03
Hexachloroethane	67-72-1	1.48E-01	7.49	7.8	***3.64E+01***
Indeno(1,2,3-cd)pyrene	193-39-5	1.99E-07	9612.54	7.8	***8.73E+02***
Isophorone	78-59-1	2.54E-04	1.56	7.8	***1.20E+02***
Lithium	7439-93-2			7.8	***TBD***

Analyte	CAS No.	Henry's Constant	Kd	Dilution Factor	Calculated Leachability at Tier I Ground Water Action Levels (mg/L)
Manganese	7439-96-5			7.8	***TBD***
Mercury	7439-97-6			7.8	TBD
Methoxychlor	72-43-5	2.60E-04	175.69	7.8	**2.52E+04**
Methylene chloride(V)	75-09-2	9.70E-02	1.30	7.8	5.77E+00
4-Methyl-2-pentanone(V)	108-10-1	9.40E-05	1.28	7.8	***2.29E+02***
2-Methylphenol	95-48-7			7.8	***TBD***
Molybdenum	7439-98-7			7.8	***TBD***
Naphthalene(V)	91-20-3	1.98E-02	4.89	7.8	***5.77E+03***
Nickel	7440-02-0			7.8	TBD
Nitrate (MCL as N)	1-005			7.8	TBD
Nitrite (MCL as N)	1-005			7.8	TBD
Nitrobenzene(V)	98-95-3	8.45E-04	1.86	7.8	***6.63E+00***
n-Nitrosodiphenylamine(V)	86-30-6	2.86E-02	3.15	7.8	***4.49E+01***
n-Nitrosodipropylamine	621-64-7	1.70E-03	1.36	7.8	***1.44E-02***
Pentachlorophenol	87-86-5	2.75E-06	121.64	7.8	9.58E+01
Phenol	108-95-2	4.54E-07	1.40	7.8	***2.67E+04***
Pyrene	129-00-0	3.39E-04	154.99	7.8	***1.34E+05***
Selenium	7782-49-2			7.8	TBD
Silver	7440-22-4			7.8	***TBD***
Strontium	7440-24-6			7.8	***TBD***
Styrene(V)	100-42-5	1.37E-01	4.35	7.8	7.13E+03
Sulfate	14808-79-8			7.8	TBD
1,1,2,2-Tetrachloroethane(V)	79-34-5	1.53E-02	2.10	7.8	***1.58E-01***
Tetrachloroethene(V)	127-18-4	7.09E-01	2.70	7.8	1.15E+01
Thallium	7440-28-0			7.8	TBD
Tin	7440-31-5			7.8	***TBD***
Toluene(V)	108-88-3	2.52E-01	2.42	7.8	2.04E+03
Toxaphene	8001-35-2	1.38E-04	3.76	7.8	1.05E+01
1,2,4-Trichlorobenzene(V)	120-82-1	1.07E-01	6.87	7.8	**1.21E+03**
1,1,1-Trichloroethane(V)	71-55-6	7.63E-01	2.17	7.8	3.78E+02
1,1,2-Trichloroethane(V)	79-00-5	4.10E-02	1.90	7.8	**5.13E-01**
Trichloroethene(V)	79-01-6	4.35E-01	2.16	7.8	9.27E+00
2,4,5-Trichlorophenol	95-95-4	2.18E-04	3.34	7.8	1.00E+04
2,4,6-Trichlorophenol	88-06-2	3.90E-06	7.72	7.8	***4.77E+01***
Vanadium	7440-62-2			7.8	***TBD***
Vinyl acetate	108-05-4	2.26E-02	1.04	7.8	***3.45E+04***
Vinyl chloride(V)	75-01-4	3.45E+00	1.24	7.8	3.03E+00
Xylene (total)(V)	1330-20-7	2.48E-01	3.08	7.8	2.56E+04
Zinc	7440-66-6			7.8	***TBD***

Values for analytes without an MCL are calculated using the corresponding residential ground water ingestion Preliminary Programmatic Remediation Goal (PPRG) which is shown in bold italics. Analytes without an MCL or a PPRG value are not listed.
(V) = Volatile chemical

Analyte	CAS No.	Henry's Constant	Kd	Dilution Factor	Calculated Leachability at Tier I Ground Water Action Levels (pCi/L)
RADIOLOGIC PARAMETERS:					
Americium-241	14596-10-2				*TBD*
Cesium-137+D	10045-97-3				*TBD*
Plutonium-239	10-12-8				*TBD*
Plutonium-240	10-12-8				*TBD*
Radium-226+D	13982-63-3				TBD
Radium-228+D	15262-20-1				TBD
Strontium-89	11-10-9				*TBD*
Strontium-90+D	11-10-9				*TBD*
Tritium	10028-17-8				*TBD*
Uranium-233+D	11-08-5				*TBD*
Uranium-234	11-08-5				*TBD*
Uranium-235+D	15117-96-1				*TBD*
Uranium-238+D	7440-61-1				*TBD*

D = Daughters

Table 5 - Surface Soil Action Levels

Analyte	CAS Number	Tier I (10E-4) Office Worker Soil (mg/kg)	Tier I (10E-4) Open Space Soil/Sediment (mg/kg)	Tier II (10E-6) Office Worker Soil (mg/kg)	Tier II (10E-6) Open Space Soil/Sediment (mg/kg)
Acenaphthene (V)	83-32-9	1.23E+07	4.61E+07	1.23E+05	4.61E+05
Acetone (V)	67-64-1	2.04E+07	7.68E+07	2.04E+05	7.68E+05
Aldrin	309-00-2	3.36E+01	1.03E+02	3.36E-01	1.03E+00
Aluminum	7429-90-5	5.93E+08	2.23E+09	5.93E+06	2.23E+07
Anthracene (V)	120-12-7	6.13E+07	2.30E+08	6.13E+05	2.30E+06
Antimony	7440-36-0	8.18E+04	3.07E+05	8.18E+02	3.07E+03
Aroclor-1016	12674-11-2	1.43E+04	5.38E+04	1.43E+02	5.38E+02
Aroclor-1221	11104-28-2	7.43E+01	2.32E+02	7.43E-01	2.32E+00
Aroclor-1232	11141-16-5	7.43E+01	2.32E+02	7.43E-01	2.32E+00
Aroclor-1242	53469-21-9	7.43E+01	2.32E+02	7.43E-01	2.32E+00
Aroclor-1248	12672-29-6	7.43E+01	2.32E+02	7.43E-01	2.32E+00
Aroclor-1254	11097-69-1	7.43E+01	2.32E+02	7.43E-01	2.32E+00
Aroclor-1260	11096-82-5	7.43E+01	2.32E+02	7.43E-01	2.32E+00
Arsenic	7440-38-2	3.27E+02	1.00E+03	3.27E+00	1.00E+01
Barium	7440-39-3	1.41E+07	5.35E+07	1.41E+05	5.35E+05
Benzene (V)	71-43-2	1.97E+04	6.17E+04	1.97E+02	6.17E+02
alpha-BHC	319-84-6	9.08E+01	2.78E+02	9.08E-01	2.78E+00
beta-BHC	319-85-7	3.18E+02	9.75E+02	3.18E+00	9.75E+00
gamma-BHC (Lindane)	58-89-9	4.40E+02	1.38E+03	4.40E+00	1.38E+01
Benzo(a)anthracene	56-55-3	7.84E+02	2.45E+03	7.84E+00	2.45E+01
Benzo(a)pyrene	50-32-8	7.84E+01	2.45E+02	7.84E-01	2.45E+00
Benzo(b)fluoranthene	205-99-2	7.84E+02	2.45E+03	7.84E+00	2.45E+01
Benzo(k)fluoranthene	207-08-9	7.84E+03	2.45E+04	7.84E+01	2.45E+02
Benzoic Acid	65-85-0	8.18E+08	3.07E+09	8.18E+06	3.07E+07
Benzyl Alcohol	100-51-6	6.13E+07	2.30E+08	6.13E+05	2.30E+06
Beryllium	7440-41-7	1.33E+02	4.08E+02	1.33E+00	4.08E+00
bis(2-Chloroethyl)ether (V)	111-44-4	5.20E+02	1.63E+03	5.20E+00	1.63E+01
bis(2-Chloroisopropyl)ether (V)	108-60-1	8.17E+03	2.56E+04	8.17E+01	2.56E+02
bis(2-Ethylhexyl)phthalate	117-81-7	4.09E+04	1.28E+05	4.09E+02	1.28E+03
Bromodichloromethane (V)	75-27-4	9.23E+03	2.89E+04	9.23E+01	2.89E+02
Bromoform (V)	75-25-2	7.24E+04	2.27E+05	7.24E+02	2.27E+03
Bromomethane (V)	74-83-9	2.86E+05	1.08E+06	2.86E+03	1.08E+04
2-Butanone (V)	78-93-3	1.23E+08	4.61E+08	1.23E+06	4.61E+06
Butylbenzylphthalate	85-68-7	4.09E+07	1.54E+08	4.09E+05	1.54E+06
Cadmium	7440-43-9	1.02E+05	3.84E+05	1.02E+03	3.84E+03
Carbon disulfide (V)	75-15-0	2.04E+07	7.68E+07	2.04E+05	7.68E+05
Carbon tetrachloride (V)	56-23-5	4.40E+03	1.38E+04	4.40E+01	1.38E+02
alpha-Chlordane	5103-71-9	4.40E+02	1.35E+03	4.40E+00	1.35E+01
beta-Chlordane	5103-74-2	4.40E+02	1.35E+03	4.40E+00	1.35E+01
gamma-Chlordane	5103-74-2	4.40E+02	1.35E+03	4.40E+00	1.35E+01
4-Chloroaniline	106-47-8	8.18E+05	3.07E+06	8.18E+03	3.07E+04
Chlorobenzene (V)	108-90-7	4.09E+06	1.54E+07	4.09E+04	1.54E+05
Chloroform (V)	67-66-3	9.38E+04	2.93E+05	9.38E+02	2.93E+03
Chloromethane (V)	74-87-3	4.40E+04	1.38E+05	4.40E+02	1.38E+03
2-Chloronaphthalene (V)	91-58-7	1.64E+07	6.14E+07	1.64E+05	6.14E+05
2-Chlorophenol (V)	95-57-8	1.02E+06	3.84E+06	1.02E+04	3.84E+04
Chromium III	7440-47-3	2.04E+08	7.68E+08	2.04E+06	7.68E+06
Chromium VI	7440-47-3	4.86E+05	3.67E+06	4.86E+03	3.67E+04
Chyrsene	218-01-9	7.84E+04	2.45E+05	7.84E+02	2.45E+03

Analyte	CAS Number	Tier I (10E-4) Office Worker Soil (mg/kg)	Tier I (10E-4) Open Space Soil/Sediment (mg/kg)	Tier II (10E-6) Office Worker Soil (mg/kg)	Tier II (10E-6) Open Space Soil/Sediment (mg/kg)
Cobalt	7440-48-4	1.23E+07	4.61E+07	1.23E+05	4.61E+05
Copper	7440-50-8	8.18E+06	3.07E+07	8.18E+04	3.07E+05
Cyanide	57-12-5	4.09E+06	1.54E+07	4.09E+04	1.54E+05
4,4-DDD	72-54-8	2.38E+03	7.46E+03	2.38E+01	7.46E+01
4,4-DDE	72-55-9	1.68E+03	5.26E+03	1.68E+01	5.26E+01
4,4-DDT	50-29-3	1.68E+03	5.16E+03	1.68E+01	5.16E+01
Dibenz(a,h)anthracene	53-70-3	7.84E+01	2.45E+02	7.84E-01	2.45E+00
Dibromochloromethane	124-48-1	6.81E+03	2.13E+04	6.81E+01	2.13E+02
Di-n-butylphthalate	84-74-0	2.04E+07	7.68E+07	2.04E+05	7.68E+05
1,2-Dichlorobenzene (V)	95-50-1	1.84E+07	6.91E+07	1.84E+05	6.91E+05
1,4-Dichlorobenzene (V)	106-46-7	2.38E+04	7.46E+04	2.38E+02	7.46E+02
3,3-Dichlorobenzidine	91-94-1	1.27E+03	3.98E+03	1.27E+01	3.98E+01
1,1-Dichloroethane (V)	107-06-2	2.04E+07	7.68E+07	2.04E+05	7.68E+05
1,2-Dichloroethane (V)	107-06-2	6.29E+03	1.97E+04	6.29E+01	1.97E+02
1,1-Dichloroethene (V)	540-59-0	9.53E+02	2.98E+03	9.53E+00	2.98E+01
1,2-Dichloroethene (total) (V)	540-59-0	1.84E+06	6.91E+06	1.84E+04	6.91E+04
2,4-Dichlorophenol	120-83-2	6.13E+05	2.30E+06	6.13E+03	2.30E+04
1,2-Dichloropropane (V)	78-87-5	8.41E+03	2.63E+04	8.41E+01	2.63E+02
cis-1,3-Dichloropropene (V)	1006-01-5	3.18E+03	9.94E+03	3.18E+01	9.94E+01
trans-1,3-Dichloropropene (V)	10061-02-6	3.18E+03	9.94E+03	3.18E+01	9.94E+01
Dieldrin	60-57-1	3.57E+01	1.10E+02	3.57E-01	1.10E+00
Diethylphthalate	84-66-2	1.64E+08	6.14E+08	1.64E+06	6.14E+06
2,4-Dimethylphenol (V)	105-67-9	4.09E+06	1.54E+07	4.09E+04	1.54E+05
Dimethylphthalate	131-11-3	2.04E+09	7.68E+09	2.04E+07	7.68E+07
2,4-Dinitrophenol	51-28-5	4.09E+05	1.54E+06	4.09E+03	1.54E+04
2,4-Dinitrotoluene	121-14-2	4.09E+05	1.54E+06	4.09E+03	1.54E+04
2,6-Dinitrotoluene	606-20-2	8.41E+02	2.63E+03	8.41E+00	2.63E+01
Di-n-octylphthalate	117-84-0	4.09E+06	1.28E+05	4.09E+04	1.28E+03
Endosulfan I	959-98-8	1.23E+06	4.61E+06	1.23E+04	4.61E+04
Endosulfan II	33213-65-9	1.23E+06	4.61E+06	1.23E+04	4.61E+04
Endosulfan sulfate	1031-07-8	1.23E+06	4.61E+06	1.23E+04	4.61E+04
Endosulfan (technical)	115-29-7	1.23E+06	4.61E+06	1.23E+04	4.61E+04
Endrin (technical)	72-26-8	6.13E+04	2.30E+05	6.13E+02	2.30E+03
Ethylbenzene (V)	100-41-4	2.04E+07	7.68E+07	2.04E+05	7.68E+05
Fluoranthene	206-44-0	8.18E+06	3.07E+07	8.18E+04	3.07E+05
Fluorene (V)	86-73-7	8.18E+06	3.07E+07	8.18E+04	3.07E+05
Heptachlor	76-44-8	1.27E+02	3.90E+02	1.27E+00	3.90E+00
Heptachlor epoxide	1024-57-3	6.29E+01	1.93E+02	6.29E-01	1.93E+00
Hexachlorobenzene	118-74-1	3.57E+02	1.10E+03	3.57E+00	1.10E+01
Hexachlorobutadiene	87-68-3	7.33E+03	2.25E+04	7.33E+01	2.25E+02
Hexachlorocyclopentadiene	77-47-4	1.42E+06	5.36E+06	1.42E+04	5.36E+04
Hexachloroethane	67-72-1	4.09E+04	1.25E+05	4.09E+02	1.25E+03
Indeno(1,2,3-cd)pyrene	193-39-5	7.84E+02	2.45E+03	7.84E+00	2.45E+01
Isophorone	78-59-1	6.02E+05	1.88E+06	6.02E+03	1.88E+04
Lithium	7439-93-2	4.09E+06	1.54E+07	4.09E+04	1.54E+05
Manganese	7439-96-5	1.01E+06	3.83E+06	1.01E+04	3.83E+04
Mercury	7439-97-6	6.13E+04	2.31E+05	6.13E+02	2.31E+03
Methoxychlor	72-43-5	1.02E+06	3.84E+06	1.02E+04	3.84E+04
Methylene chloride (V)	75-09-2	7.63E+04	2.39E+05	7.63E+02	2.39E+03

Analyte	CAS Number	Tier I (10E-4) Office Worker Soil (mg/kg)	Tier I (10E-4) Open Space Soil/Sediment (mg/kg)		Tier II (10E-6) Office Worker Soil (mg/kg)	Tier II (10E-6) Open Space Soil/Sediment (mg/kg)
4-Methyl-2-pentanone (V)	108-10-1	1.64E+07	6.14E+07		1.64E+05	6.14E+05
2-Methylphenol	95-48-7	1.02E+07	3.84E+07		1.02E+05	3.84E+05
Molybdenum	7439-98-7	1.02E+06	3.84E+06		1.02E+04	3.84E+04
Naphthalene (V)	91-20-3	8.18E+06	3.07E+07		8.18E+04	3.07E+05
Nickel	7440-02-0	4.09E+06	1.54E+07		4.09E+04	1.54E+05
Nitrobenzene (V)	98-95-3	1.02E+05	3.84E+05		1.02E+03	3.84E+03
n-Nitrosodiphenylamine (V)	86-30-6	1.17E+05	3.65E+05		1.17E+03	3.65E+03
n-Nitrosodipropylamine	621-64-7	8.17E+01	2.56E+02		8.17E-01	2.56E+00
Pentachlorophenol	87-86-5	4.77E+03	1.49E+04		4.77E+01	1.49E+02
Phenol	108-95-2	1.23E+08	4.61E+08		1.23E+06	4.61E+06
Pyrene	129-00-0	6.13E+06	2.30E+07		6.13E+04	2.30E+05
Selenium	7782-49-2	1.02E+06	3.84E+06		1.02E+04	3.84E+04
Silver	7440-22-4	1.02E+06	3.84E+06		1.02E+04	3.84E+04
Strontium	7440-24-6	1.23E+08	4.61E+08		1.23E+06	4.61E+06
Stryene (V)	100-42-5	4.09E+07	1.54E+08		4.09E+05	1.54E+06
1,1,2,2-Tetrachloroethane (V)	79-34-5	2.86E+03	8.95E+03		2.86E+01	8.95E+01
Tetrachloroethene (V)	127-18-4	1.10E+04	3.44E+04		1.10E+02	3.44E+02
Tin	7440-31-5	1.23E+08	4.61E+08		1.23E+06	4.61E+06
Toluene (V)	108-88-3	4.09E+07	1.54E+08		4.09E+05	1.54E+06
Toxaphene	8001-35-2	5.20E+02	1.59E+03		5.20E+00	1.59E+01
1,2,4-Trichlorobenzene (V)	120-82-1	2.04E+06	7.68E+06		2.04E+04	7.68E+04
1,1,2-Trichloroethane (V)	79-00-5	1.00E+04	3.14E+04		1.00E+02	3.14E+02
Trichloroethene (V)	79-01-6	5.20E+04	1.63E+05		5.20E+02	1.63E+03
2,4,5-Trichlorophenol	95-95-4	2.04E+07	7.68E+07		2.04E+05	7.68E+05
2,4,6-Trichlorophenol	88-06-2	5.20E+04	1.59E+05		5.20E+02	1.59E+03
Vanadium	7440-62-2	1.43E+06	5.38E+06		1.43E+04	5.38E+04
Vinyl acetate	108-05-4	2.04E+08	7.68E+08		2.04E+06	7.68E+06
Vinyl chloride (V)	75-01-4	3.01E+02	9.42E+02		3.01E+00	9.42E+00
Xylene (total) (V)	1330-20-7	4.09E+08	1.54E+09		4.09E+06	1.54E+07
Zinc	7440-66-6	6.13E+07	2.30E+08		6.13E+05	2.30E+06
Nitrate	1-005	3.27E+08	1.23E+09		3.27E+06	1.23E+07
Nitrite	1-005	2.04E+07	7.68E+07		2.04E+05	7.68E+05
Fluoride	16984-48-8	1.23E+07	4.61E+07		1.23E+05	4.61E+05

Values are based on PPRG calculations for the specified exposure scenario. All toxicity values used in calculations are from IRIS, from HEAST, or are approved by the EAOC. Analytes without PPRGs are not listed.
(V) = Volatile chemical

Analyte	CAS Number	Tier I				Tier II (10E-6)	
		Office Worker - Soil		Open Space - Soil/Sediment		Office Worker Soil (pCi/g)	Open Space Soil/Sediment (pCi/g)
		10E-4 Risk (pCi/g)	15 mrem Dose (pCi/g)	10E-4 Risk (pCi/g)	15 mrem Dose (pCi/g)		
RADIOLOGIC PARAMETERS:							
Americium-241	14596-10-2	7.67E+02	TBD	2.36E+03	TBD	7.67E+00	2.36E+01
Cesium-137+D	10045-97-3	7.97E+00	TBD	7.97E+00	TBD	7.97E-02	7.97E-02
Plutonium-239	10-12-8	1.01E+03	TBD	6.98E+03	TBD	1.01E+01	6.98E+01
Plutonium-240	10-12-8	1.01E+03	TBD	6.98E+03	TBD	1.01E+01	6.98E+01
Radium-226+D	13982-63-3	2.47E+00	TBD	2.47E+00	TBD	2.47E-02	2.47E-02
Radium-228+D	15262-20-1	5.06E+00	TBD	5.08E+00	TBD	5.06E-02	5.08E-02
Strontium-89	11-10-9	1.55E+04	TBD	2.71E+04	TBD	1.55E+02	2.71E+02
Strontium-90+D	11-10-9	5.72E+03	TBD	3.98E+04	TBD	5.72E+01	3.98E+02
Tritium	10028-17-8	4.48E+06	TBD	3.11E+07	TBD	4.48E+04	3.11E+05
Uranium-233+D	11-08-5	1.82E+04	TBD	9.97E+04	TBD	1.82E+02	9.97E+02
Uranium-234	11-08-5	7.08E+03	TBD	4.67E+04	TBD	7.08E+01	4.67E+02
Uranium-235+D	15117-96-1	6.23E+01	TBD	6.28E+01	TBD	6.23E-01	6.28E-01
Uranium-238+D	7440-61-1	2.99E+02	TBD	3.15E+02	TBD	2.99E+00	3.15E+00

D = daughters

TBD = To be determined by Working Group